Compressed Air Magazine

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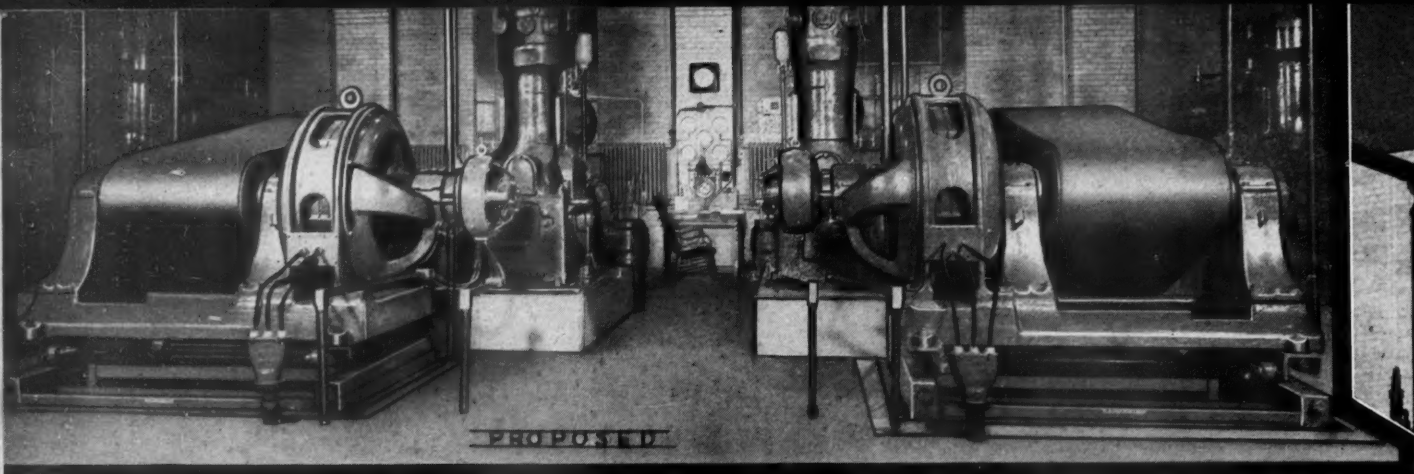
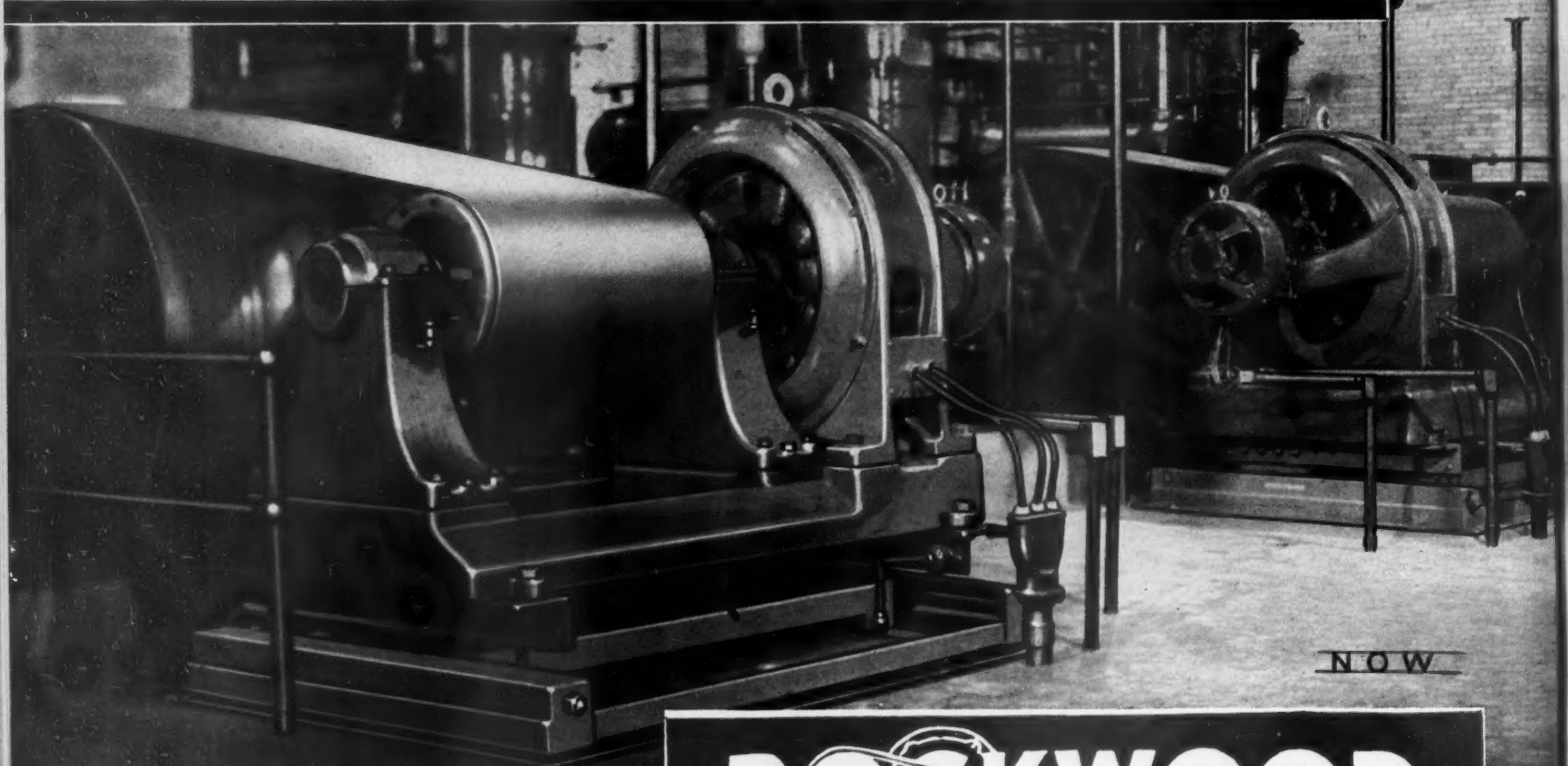
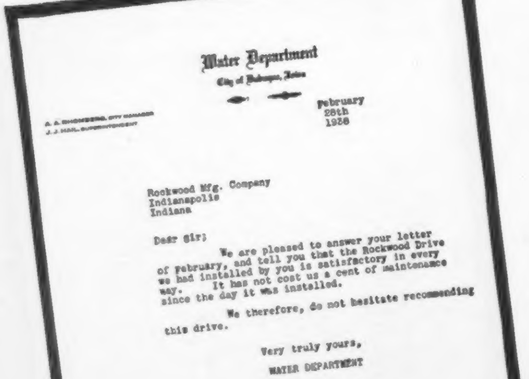




ROCKWOOD
PIVOTED MOTOR DRIVE

Two Sullivan air compressors driven by Rockwood Drives from two 400 h.p., 718 r.p.m. synchronous motors. These big compressor drives have paid for themselves quickly in power and belt savings.



Water Department
City of Dubuque, Iowa

J. J. Hail, Superintendent

February
28th
1938

Rockwood Mfg. Company
Indianapolis
Indiana

Dear Sir;

We are pleased to answer your letter of February, and tell you that the Rockwood Drive we had installed by you is satisfactory in every way. It has not cost us a cent of maintenance since the day it was installed.

We therefore, do not hesitate recommending this drive.

Very truly yours,
WATER DEPARTMENT

Superintendent.

B;f

The first Rockwood drive was installed in 1932. It was so outstandingly successful, the second Rockwood Drive was put in a year later. In 1938—after both drives have been running for five years—customer writes the above letter.

What one user thinks after five years of service. . . .

This is the story and the record of two big 400 h.p. Rockwood **pivoted-motor** Short Center flat belt Drives at the Dubuque City Water Works, Dubuque, Iowa. Through the courtesy of J. J. Hail, Superintendent, we are able to report what they think after both drives **have been installed and in continuous service for five years.**

"Satisfactory in every way"—"–has not cost us a cent of maintenance since the day it was installed"—strong evidence of what you can expect of ANY Rockwood Drive on **any** belt driven machine that you install. The unfailing principle of gravity controlled belt tension in the Rockwood Drive works equally well on small fractional h.p. motors as on large motors and generators weighing thousands of pounds. Adjustments in the Rockwood pivoted base permit the belt tension first to be correctly established and then forever after to be automatically maintained at the *minimum* required to handle the *maximum* load. Stock bases are available for motors up to 100/150 h.p. Larger sizes quickly available. Belt stretch—either flat belt or V-belt—is taken up automatically. Driven speeds are uniform, regardless of load.

Industry is turning to this more dependable, more economical short center belt drive because it makes driven machines perform more satisfactorily and at less cost. WRITE US ABOUT YOUR DRIVES. You should by all means consider the Rockwood Drive every time you change an existing drive or buy a new one.

Rockwood Manufacturing Company—*Indianapolis, Indiana*

OUR COVER PICTURE

THE five stacks silhouetted against the skyline of mid-Manhattan surmount one of the several large stations that generate power for operating New York City's ramified underground and elevated railway systems. This one is owned by the Interborough Rapid Transit Company and occupies an entire block on the west side of the island that is bounded by 59th and 60th streets and 11th and 12th avenues. It was erected in 1903, the year before the first subway line was opened, and has since been improved and enlarged several times. It burns 740,000 tons of coal a year and has a capacity of 155,000 kw. of electric energy, which operates 117 route-miles of railroad. The Interborough maintains a second power plant of the same size on the east side of the island, and the two can be used independently or together. The current from each is distributed to the areas served through the medium of 25 substations. The spire of the Chrysler Building is shown at the extreme left, and the Empire State Building appears between the two end stacks at the right.

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IN THIS ISSUE

ALTHOUGH it is the premier city of the world in many respects, New York has admittedly been backward in the matter of adequately disposing of its sewage. Now, however, it has taken the matter firmly in hand and inaugurated a great construction program that will, in years to come, clear up the waterways contiguous to the Metropolis, remove the menace to public health that hangs over some of its bathing beaches, and perhaps even bring back the shad and other fishes that once frequented the harbor. The first step in this momentous program is described in our leading article.

●

WESTERN American farmers may some day grow their own automobile tires. Sounds fantastic; but a reading of our second article will bring out the fact that the statement is not without plausibility. Twenty years of experience has solved most of the problems encountered in cultivating and processing the rubber-bearing guayule shrub. The immediate future of the industry will depend largely upon the trend in rubber prices; but eventually quantity-production methods will perhaps make the guayule a real competitor of the *Hevea* tree.

●

PUMP users should be interested in the description of a testing laboratory that is presented as our third article. It will surprise many of them to learn how much money, time, and effort are expended to maintain the standards of performance of a high-quality product. From the manufacturer's standpoint, the laboratory has proved itself well worth while as an aid in improving pump design and construction. It has played a big part in bringing about a remarkable improvement in the hydraulic performance of a line of pumps that has been favorably known in the mining and industrial fields for many decades.

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ADDENDUM

THE air-operated pickling plant described on page 5566 of the March, 1938, issue was built for the Rasselsteiner Eisenwerksgesellschaft and is in use in its plant at Neuwied-Rasselstein, Germany.

Compressed Air Magazine

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EDITORIAL CONTENTS

ADVERTISING INDEX

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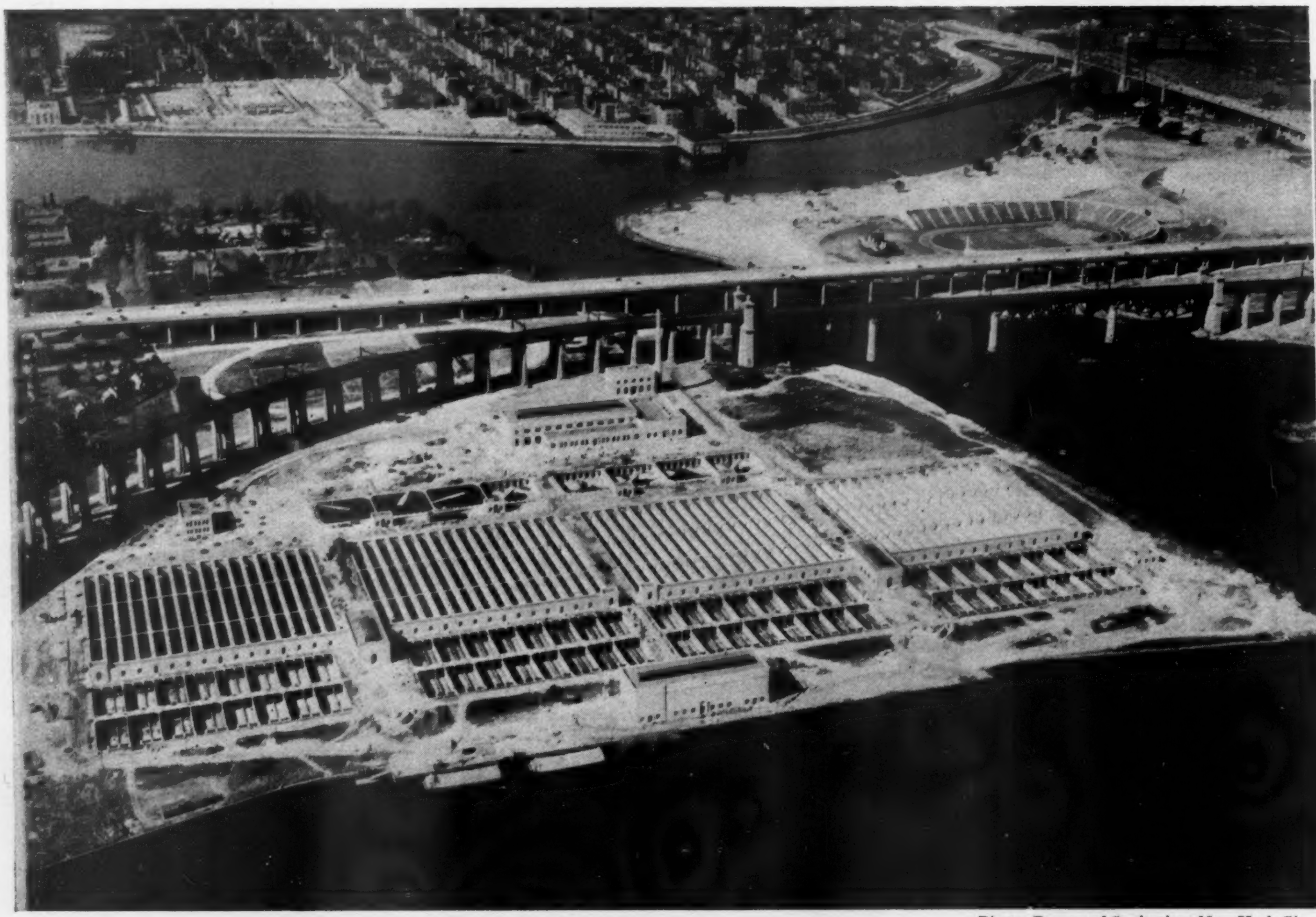


Photo, Bureau of Sanitation, New York City

WARDS ISLAND TREATMENT WORKS

An aerial view of the plant that can treat 190,000,000 gallons of sewage every 24 hours, or about one-fifth of the total daily outflow of New York City's sewers. It serves sections of the boroughs of Manhattan and The Bronx aggregating 7,567 acres and populated by 1,168,000 persons. Just beyond the plant are the Pennsylvania-New Haven railroad tracks and a part of the Triborough highway bridge. In the upper right-hand area is the Randall's Island Stadium with the Manhattan approach to the Triborough Bridge running alongside. Extending across the top is the eastern edge of Manhattan, with a small section of The Bronx visible at the extreme upper right.

New York City Attacks Its Sewage Problem

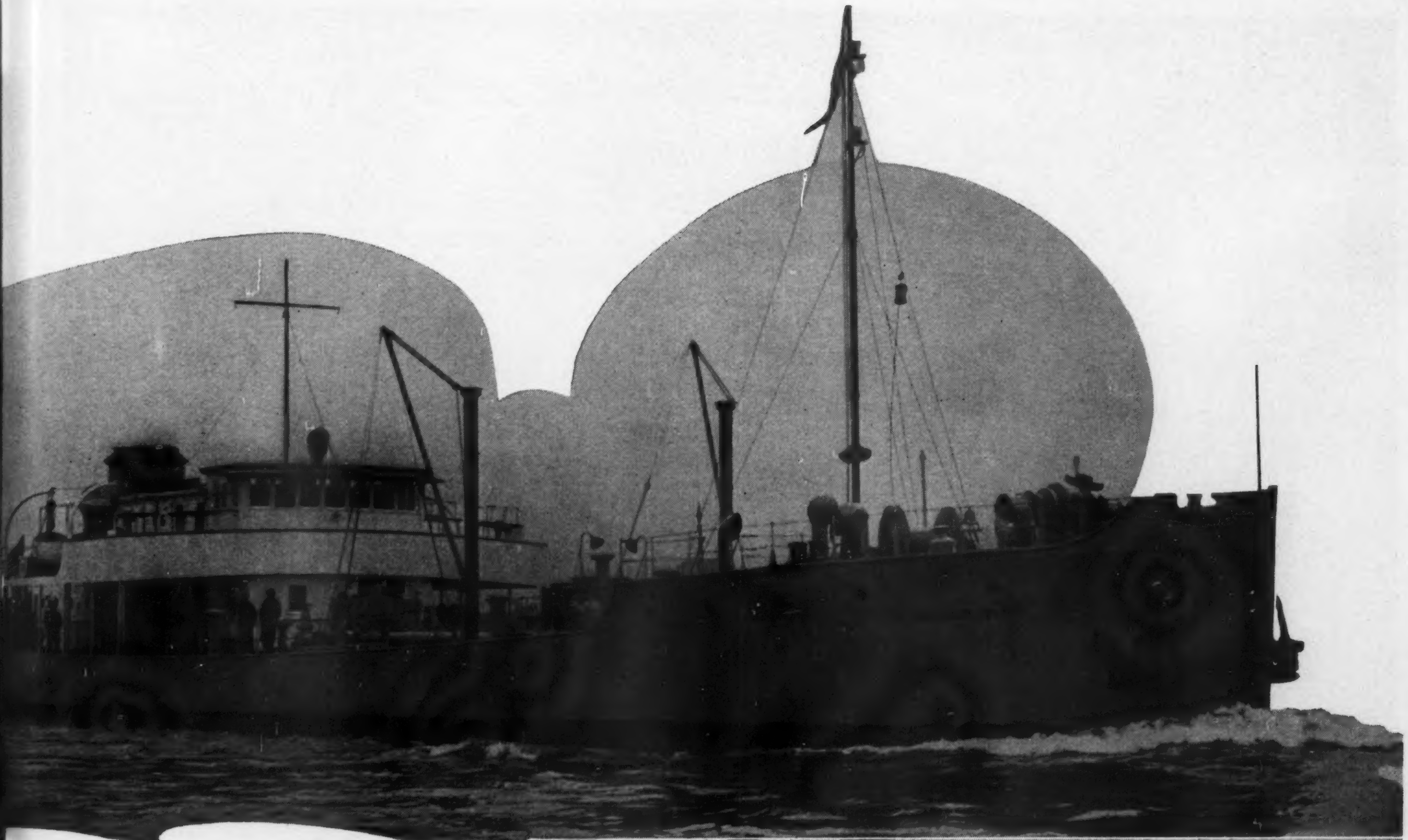
Robert G. Skerrett

" 'The time has come,' the Walrus said,
'To talk of many things;
Of shoes—and ships—and sealing-wax—
Of cabbages—and kings.' "

IF THE Walrus of *Alice in Wonderland* were the present analyst he would surely emphasize sanitation, sewage, and ships among his topic matter by telling what the City of Greater New York has done in building on Wards Island a splendid sewage treatment plant and in calling into being a fleet of special vessels to link that plant with the open sea—all at a cost of substantially $30,000,000. But as we are dealing with fact and not fancy, we shall have to approach our subject in a more practical way, even though the general public and most of the responsible public officials seemingly have been up in the clouds in the decades gone in facing the problem of sewage disposal of America's largest city and most important seaport.

In 1790, the areas now forming the five boroughs of the Metropolis had an aggregate population of a little less than 50,000, while the same boroughs, now associate divisions of the greater city, had an estimated population of 7,500,000 at the close of the past year. Such has been the growth in nearly a century and a half. And yet we are authoritatively informed that for more than two and a quarter centuries prior to the present virtually nothing was done within the Metropolis to prevent the sewage of the far-flung community from polluting the adjacent rivers and bays. This situation seems astonishing when one ponders the fact that polluted waters, in the physical circumstances surrounding the Metropolis, are inevitably a menace to the well-being of the public at large.

Mr. Walter D. Binger, deputy commissioner, and Richard H. Gould, chief engineer, Department of Sanitation of New York City, thus summed up the matter in a paper prepared by them a little more than a year ago: "The complete indifference to pollution which existed in New York City previous to 1935 is shown by the fact that whereas over 90 per cent of the urban population, or about 7,000,000 people, are connected to the city sewers, the sewage of only about one-fifth, or 1,400,000, was handled by the screening plants—the remainder being discharged untreated . . . . . The entire inner harbor is so loaded with dangerous bacteria that for many years the Department of Health has refused to issue permits for bathing in these waters . . . . . . One of the most important objects of sewage treatment is to permit the people of New York City to frequent waterside parks and buildings near the waterfront and to travel on the waters without encountering visual evidences of sewage.



It goes without saying that stenches arising from septic decomposition in the waters cannot be tolerated. The desirability of using certain sections of the harbor for recreation would seem to warrant adequate sewage treatment. What makes it even more important is that some of the present bathing places cannot be continued in use unless that action is taken."

The Wards Island Sewage Treatment Works is the city's foremost effort to deal with the long-neglected problem and to establish initial facilities capable of handling 190,000,000 gallons of sewage every 24 hours—the total outflow of all the municipal sewers being about 1,000,000,000 gallons a day. The Wards Island plant is at the junction of the East and Harlem rivers, an area that heretofore has been seriously polluted by sewage; and the installation is counted upon, at this time, to treat the sewage reaching it from the southwestern section of the Borough of The Bronx and the northeastern section of the Borough of Manhattan. Within the combined areas of 7,567 acres, there is a resident population of 1,168,000. In The Bronx, during the current year, the drainage system will tap an additional area of 3,025 acres with 157,000 people and with the population growing rapidly.

The 9¼ miles of intercepting sewers, which are largely in solid rock and which collect from 60 tributary sewers in Manhattan and The Bronx, terminate at two

Photo, United Shipyards, Inc.

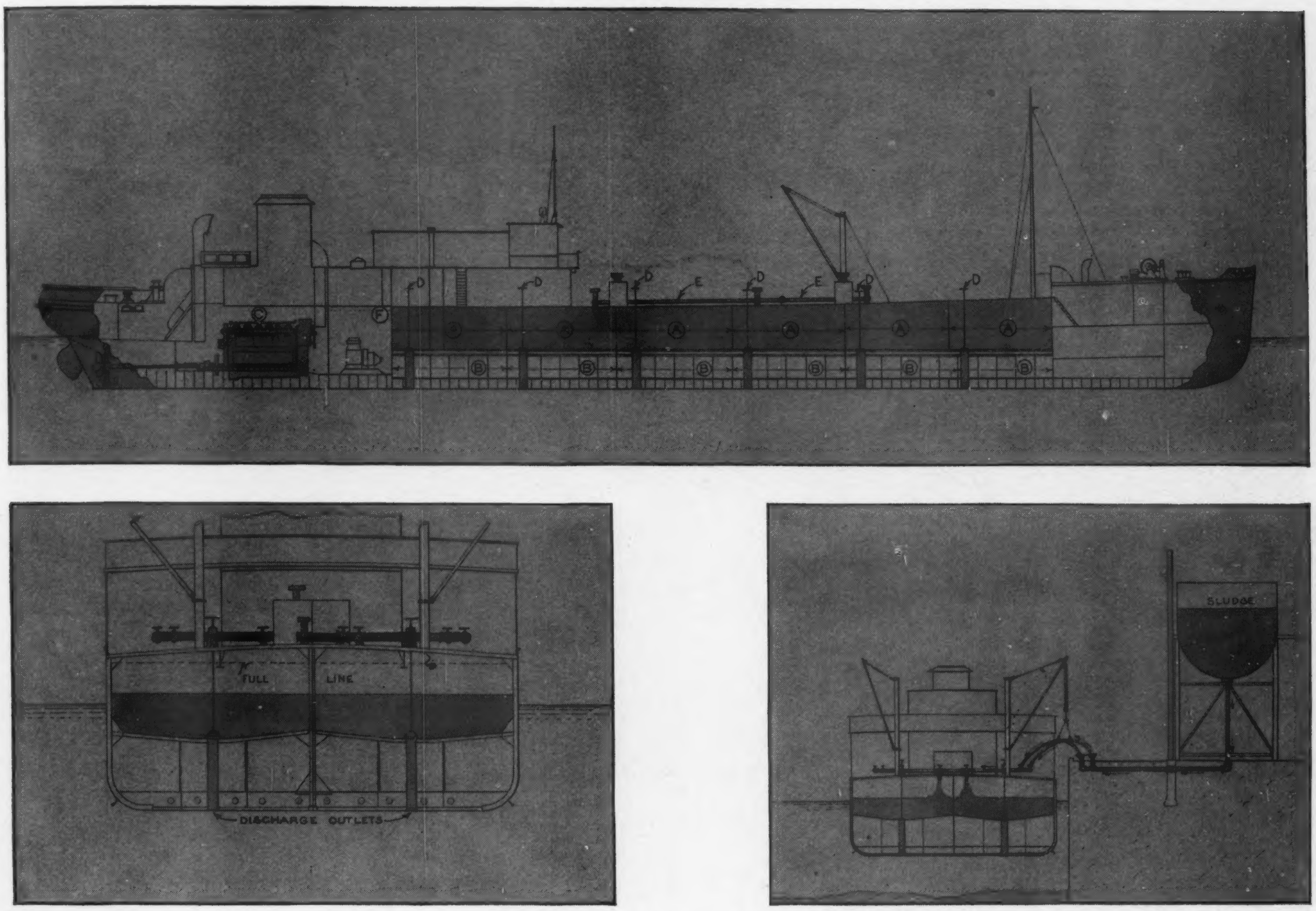
ONE OF THE SLUDGE CARRIERS

At the top is the "Tallmans Island," second of the three boats built at a cost of approximately $1,500,000 to transport sludge from the new Wards Island Sewage Treatment Works to sea for disposal. They are the first self-propelled vessels ever to be designed and constructed especially for that purpose. The bottom picture was taken as one of the main heavy-oil propulsion engines was being lowered into the "Tallmans Island." Note the external simplicity of the driver, which, because of its compactness, could be shipped from the factory largely in assembled form.

227,000 CFM. OF AIR

These six Ingersoll-Rand turbo-blowers supply the air for aerating the sewage and, incidentally, furnish the oxygen that plays an all-important part in the purifying process. They constitute the largest installation of blowers for this purpose in existence. Each machine is driven by a 2,000-hp. motor. Four of the units have individual capacities of 42,500 cfm., and the two others of 28,500 cfm. each at a normal rated pressure of 7.3 pounds per square inch. At the right is a small section of the 64 large aerating tanks in which activated sludge is added to the sewage and the resultant mixture is thoroughly agitated with air introduced through thousands of small openings in the bottoms of the tanks.

Photo, Bureau of Sanitation, New York City



SECTIONS THROUGH SLUDGE BOAT

In the longitudinal section, top, *A* indicates sludge compartments; *B*, buoyancy compartments; *C*, oil engines; *D*, discharge valves; *E*, sludge-filling main; *F*, fuel-oil tanks. The transverse section at the lower left illustrates the sludge-filling line on the main deck and connections with the underlying sludge compartments beneath which are the buoyancy compartments. Note the discharge-valve controls on the main deck and the 18-inch outlet pipes by which the sludge tanks are evacuated. At the lower right is a cross section of a vessel and the loading dock at Wards Island, showing the construction of the elevated tanks and how they deliver sludge to the boat by gravity.

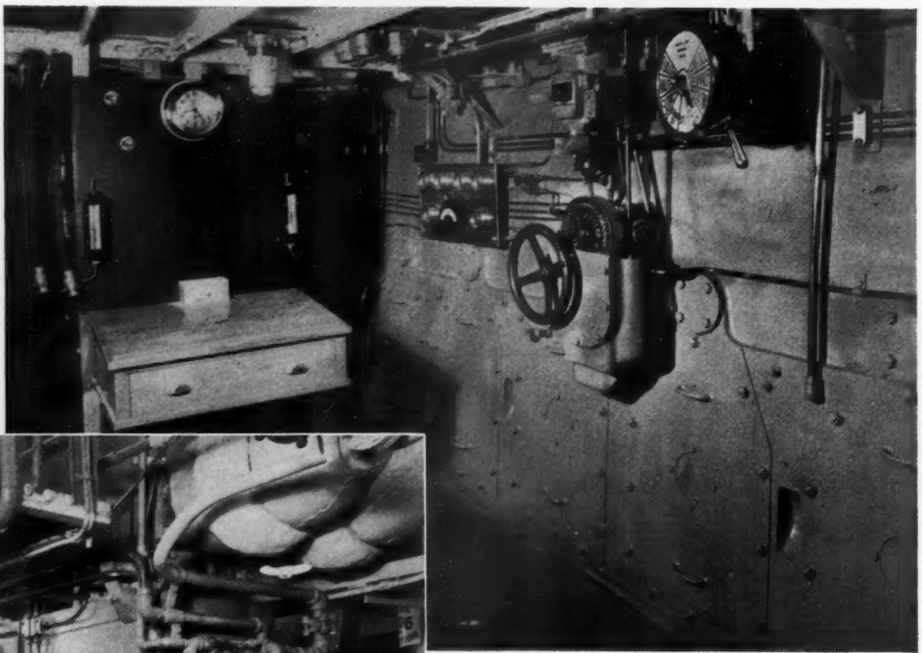
points: one close to the shore of the Bronx Kill and the other on a flank of the East River at 110th Street, Manhattan. At each of these terminals the sewage enters a capacious grit chamber, where the larger or heavier solids are arrested while the remainder flows onward through two rock-driven, concrete-lined tunnels to the great treating plant on Wards Island. The tunnel between The Bronx grit chamber and Wards Island has a length of 5,630 feet and an internal diameter of 10½ feet, and traces its course at a depth of 150 feet beneath the Bronx Kill, Randall's Island, Little Hell Gate, and a part of Wards Island before reaching the union discharge shaft on the latter. The tunnel between the Manhattan grit chamber and the discharge shaft is 3,392 feet long and has an inside diameter of 8½ feet. The Manhattan Tunnel, because of the interposition of a deep vertical wedge of faulted water-bearing rock—unexpectedly encountered—had to be carried under the river at the great depth of 520 feet to assure a passage through sound rock. Despite the difficulties encountered, the contractor did the work so rapidly and well that the ultimate cost did not exceed the original estimate for the job.

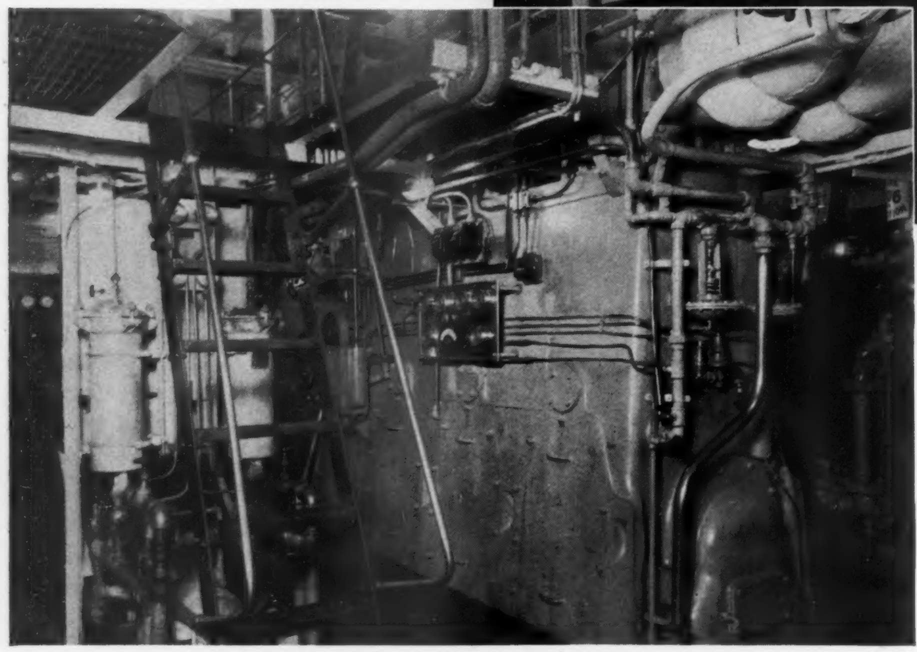
When the sewage from both tunnels reaches the union shaft on Wards Island it is picked up by a group of six big electrically driven pumps, each with a daily capacity of 90,000,000 gallons, and distributed thence to the different sections of the expansive treatment plant. The sewage is treated by the activated-sludge process in which mechanical action and bacterial activity are relied upon to remove the solids in suspension and to produce an effluent that is so largely purified that it can be discharged into the nearby river without fear of dangerous contamination of the tidal waters. The plant is capable of handling every 24 hours a maximum of about 730,000 tons of sewage and recovering therefrom suspended objectionable solids representing approximately 1 per cent of the total volume by weight. It is this very small percentage of solid matter in suspension that is responsible for the pollution of waters into which untreated sewage is discharged. The plant is therefore designed to bring about the precipitation of the troublesome solids and then to store them for a short span of hours, after which the concentrated sludge is transported to an offshore area and discharged into the open sea.

The first step in the process is to deliver the sewage from the union shaft to a group of big settling tanks in each of which is a slow-moving, rotary, mechanical clarifier which sweeps a submerged scraper arm through the sewage and causes the heaviest of the sludge to settle. Next it is pumped to a group of immense aerating tanks that are subdivided so as to form 64 large tanks. In these the sewage is mixed with a percentage of activated sludge—really a sort of leaven—and then agitated with mounting streams of compressed-air bubbles issuing from the bottom of each tank. The air propagates and stimulates oxygen-breathing bacteria which attack the putrescible matter in the solution and induce the formation of a "floc"—a flocculent state of the suspended solid matter. In that condition the sewage is pumped to a second series of 64 tanks—known as the

PROPULSION ENGINES

Each of the three vessels is powered by two Ingersoll-Rand Type PR 6-cylinder, 4-cycle, solid-injection, heavy-oil engines. They develop 650 bhp. at 260 rpm., or 715 bhp. at 270 rpm. Each engine is connected through Kingsbury thrust bearings to a propeller shaft. The boats have a guaranteed speed of 10.25 knots when fully loaded. The picture below shows the operating side of the port engine, and the one at the right the starboard engine with the operator's table to the left.





final settling tanks—in which the activated sludge settles and from which it is removed by a succession of belt-like scrapers. After that it is conveyed to a number of elevated storage tanks located in a building close to the waterside. Some of the activated sludge is returned to the aerating tanks, while the remainder is fed by gravity to the vessels that carry it out to sea. The clear sewage which flows away from the final settling tanks after the sludge is precipitated is highly purified and inoffensive, and can be discharged into the nearby river without any risk of contaminating the waters.

To aerate a maximum of 190,000,000 gallons of sewage a day calls for the use of a very large volume of compressed air. To this end, the Wards Island plant is provided with six Ingersoll-Rand turbo-blowers, each driven by a single 2,000-hp. induction motor. Two of the turbo-blowers have a capacity each of 28,500 cubic feet of air per minute, and the four other larger units deliver 42,500 cfm. each. The discharged air has an average rated pressure of 7.3 pounds per square inch; but when the volume of output is reduced, the pressure is increased, or, conversely, the pressure is lowered when the volume of the discharge is raised above the normal. In other words, the quantity of air and the pressure can be varied to meet different operating conditions.

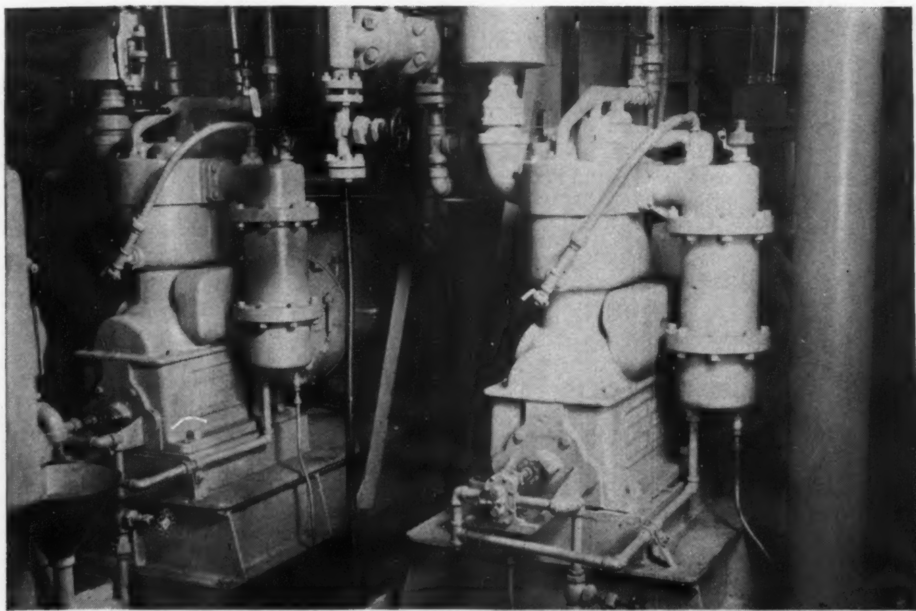
The sludge that accumulates from day to day in the elevated tanks on Wards Island is carried 33 miles out to an area in the open Atlantic 8 miles seaward from the Scotland Lightship, where it can be dumped without any likelihood of polluting the waters that wash the neighboring shores of Long Island and New Jersey which are dotted with bathing and seaside resorts. This requires the services of one or more of the three special vessels that the City of New York has had built for the purpose at a total cost of substantially $1,500,000. The craft are somewhat unique, and were developed to meet the particular conditions under which they have to operate. They were designed by Cox & Stevens, Inc., naval architects, New York City, and were constructed by United Shipyards, Inc., at Mariners Harbor, Staten Island, N. Y.

Efficient and economical operation was essential to satisfactory service on the part of the sludge vessels. This entailed gravity loading at the Wards Island wharf and gravity discharge after reaching the offshore dumping area. This eliminated the need of pumps and of power consumption in the final handling of the material. It was also essential that main and auxiliary drive should cost as little as practicable. Therefore heavy-oil engines are relied upon to propel the boats and to drive the principal auxiliary units. The ships have been given seaworthy qualities and have ample speed to enable them to do their work well under all probable conditions. Each has a goodly cargo capacity and can be loaded rapidly and discharged in a few minutes. The principal dimensions are:

Length over-all, about	260.0 feet
Length of load water line	250.0 "
Beam, molded	43.5 "
Depth, molded, amidships	16.0 "
Designed mean load draft, molded	11.0 "
Mean freeboard at 11-foot draft	5.0 "

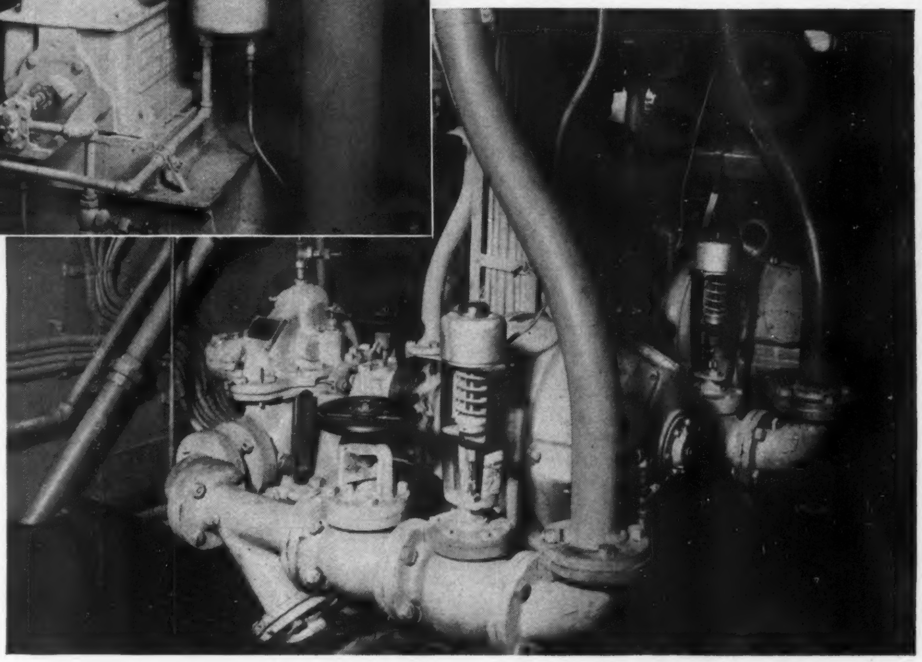
The hull and superstructure are of steel construction with the exception of the roofing of the housing and the guard rails, which are of wood. There are but two decks within the hull, which is subdivided longitudinally into seven principal watertight compartments by six transverse bulkheads that extend from the keel to the underside of the main deck. The dead-weight cargo capacity on a full-load draft of 11 feet is 1,600 short tons, and the total volume of the multiple sludge compartments is 55,000 cubic feet. For propulsion there are two heavy-oil engines each driving a separate screw—the specifications requiring that these main engines shall assure a speed of 10¾ knots with the boat in the light condition and 10¼ knots when fully loaded. The fuel-oil tanks have a combined capacity of 70 long tons—ample for a cruising radius when deep laden and at full speed of 2,500 miles. Any of the vessels can therefore be kept in service continuously for several weeks without refueling.

Normally, each ship carries seventeen persons—officers and crew, but there are accommodations for three more should cir-



MAIN ENGINE AUXILIARIES

Cooling water for the propulsion engines is supplied by two Ingersoll-Rand motor-driven, 2-inch centrifugal pumps (below) each with a capacity of 140 gpm. against a head of 70 feet. Starting air for the engines is furnished at 500 pounds pressure by the two motor-driven Ingersoll-Rand Type 20 compressors, each of 40 cfm. capacity, at the left.



cumstances call for an added force. The officers are quartered in the upper deckhouse on the boat deck and immediately abaft the pilothouse, while most of the crew is accommodated within the housing on the main deck just below. The oilers have their quarters abaft the engine room on the lower deck. The living spaces are equipped with all necessary conveniences for the comfort and well-being of the complement.

The two main propelling engines are Ingersoll-Rand direct-reversible, 6-cylinder, 4-cycle, solid-injection, heavy-oil marine units which develop 650 bhp. each when turning over at 260 rpm. However, in accordance with the architects' specifications, the engines were designed so that they could deliver a continuous overload of 10 per cent at 270 rpm. They are directly connected to their respective driving shafts through Kingsbury thrust bearings; and each propeller is outward turning when driving ahead to assure prompt response to rudder movements. Twin rudders are provided to give the fullest maneuvering power at all drafts and at any speed affording steerageway. At light draft, the vessels draw only 5 feet of water, and when full laden their draft is 11 feet. The rudders, accordingly, must be effective through a variable range of 6 feet—hence the reason for adopting twin, parallel rudders which are operated in unison by opposed-ram, electric-hydraulic steering gear. During her trial trip, the first boat to be commissioned did nearly a knot better than the maximum speed called for under the contract, thus indicating that the propelling engines were capable of developing more power than the specifications required.

Starting air for the two main engines is furnished by two electrically driven 5½ & 2¾ x 5-inch stroke Ingersoll-Rand compressors each having a capacity of 40 cfm. at a discharge pressure of 500 pounds per square inch. There is also an auxiliary compressor with a capacity of 8 cfm. at a pressure of 500 pounds per square inch. This air is for various purposes—among them the operating of the two whistles mounted on the front of the stack. The starting air for the main engines and for the oil-engine-driven electric generators, of which there are two, is stored in six air receivers placed in the engine room. All auxiliary power is primarily developed by a number of oil-engine-driven units; and electrically driven pumps are provided for fire, bilge, and ballast service—including the distribution of fresh and salt water for engine circulation and other uses. Circulating water for the two main engines is supplied by two motor-driven 2-inch Cameron centrifugal pumps, each having a capacity of 140 gpm. at a total head of 70 feet. In addition to the fire mains, each boat carries a carbon-dioxide fire-extinguishing system.

The broad adoption of heavy-oil engines, in lieu of steam drive, makes for operating economy as well as promptness in bringing any of the machinery into action at full power. Steam for heating is furnished by a small oil-burning boiler in the engine room; and the boiler also is the source of hot water distributed throughout each ship. Radiators are installed in all living spaces. The oil burner under the boiler is equipped with automatic pressure control. Natural ventilation is relied upon to keep the air fresh in all working and living spaces; but electric fans are installed to stimulate circulation wherever and whenever a freer movement is desirable. Mounted on the forecastle deck is a windlass with electric drive for handling either of the 3,500-pound anchors when raising it from 30 fathoms of water at a rate of 24 feet a minute. Aft, on the main deck near the stern, is an electrically driven capstan, which is capable of developing a pull of 6,000 pounds and can be used to handle ropes or cables in warping or maneuvering the vessel when docking her or shifting her when not underway.

The cargo space, which extends from the forecastle bulkhead aft to the engine-room bulkhead, is primarily divided into six main subdivisions by a continuous center-line, watertight bulkhead and by two intermediate, transverse, watertight bulkheads. These compartments are again subdivided into chambers of uniform length by transverse, nonwatertight partitions that function as swash bulkheads to arrest any fore-and-aft surging of the sludge when the boat pitches in a seaway. The center-line bulkhead minimizes any lateral surge that may be induced by rolling of the craft. The net effect of this subdivisioning of the hold into

twelve unit spaces is to reduce shifting of the cargo as far as practicable whenever the compartments are not completely filled and the fluid mass has a free surface.

Beneath and throughout the entire length and breadth of the sludge compartments there is a succession of air spaces which assures the vessel the necessary reserve of buoyancy when loaded; and forward and aft of the buoyancy compartments are ballast tanks that can be filled or drained of water to give her any desired trim so as to compensate for her condition of loading. Each sludge tank has a connection with the sea by way of an 18-inch, wrought-iron pipe that leads from the bottom of the tank down through the underlying buoyancy compartment. At the top of that pipe, in the sludge compartment, is a valve which can be opened or closed by the turning of an attached stem that extends up to a hand wheel on the main deck. As can be seen on an accompanying cross section, the valve is placed at the low point and on the center line of the sloping bottom of each tank so that all the sludge can flow out when the valve is lifted.

On the main deck is a sludge-filling main, 14 inches in diameter, that has connections with the principal divisional compartments, and there are also vents which can be opened or closed to permit the escape of air from the compartments as they are successively filled with sludge. Overflow trunks or passages, rising from the main deck, provide outlets for any excess sludge that may be delivered to the compartments during the loading operations.

The sludge-filling main is parallel with the center line of the craft. Extending from that line and nearly across the boat is another 14-inch pipe at each outer end of which is a Y formed of two 10-inch pipes with suitable fittings for flexible pipes or hose also 10 inches in diameter. By means of the latter the vessel is linked on one side or the other with a corresponding number of connections on the wharf at Wards Island that tap the sludge tanks in the nearby storage building. The flexible connections are long enough to permit loading at all times and at any stage of the tide. The twin hose are supported during loading by booms mounted on derrick posts, one at each side of the boat; and a hand winch on each post is available for hoisting, lowering, or otherwise handling the hose.

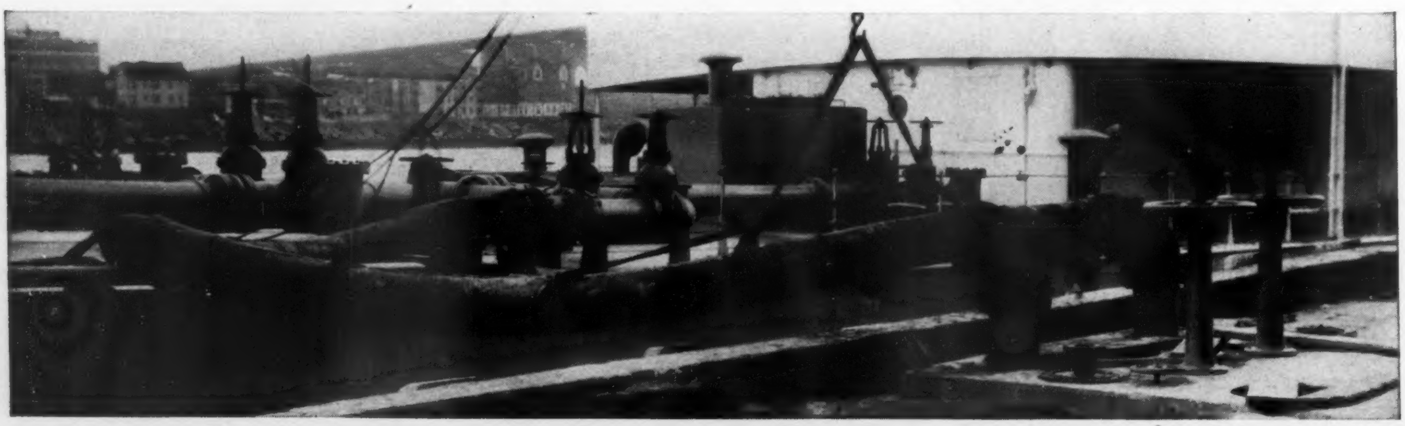
When the ship is thus connected with the filling line from any of the elevated storage tanks, the sludge flows by gravity and is distributed in proper succession to the various compartments. Loading is controlled so as to fill twin flanking compartments simultaneously and to keep the craft on an even keel as the work proceeds. In each compartment is installed a float gauge which is arranged to indicate visibly from the deck when it is nearing fullness. This assures nice control during the final stages of loading.

At the time of loading, the sludge consists of about 95 per cent water and of 5 per cent solid matter, and is therefore extremely fluid. When full laden the vessel draws 11 feet of water and the top surface of the sludge in the compartments is 5 feet above her load line. To get her in that condition takes about one hour. The 5-foot head makes it possible for the sludge to discharge freely and quickly as soon as the outlet valves are opened. As the boat evacuates herself she rises in the water; but even when her sludge tanks are nearly emptied there is a head of not less than 9 inches between the bottoms of the tanks and the surface of the water supporting the ship. That remaining head suffices to cause the last of the sludge to leave the tanks and to pass outboard.

After the vessel has reached the designated area in the open sea, preparations are at once made to discharge cargo. She is slowed down, and then her engines are reversed and she is given sternway before the outlet valves are raised and the sludge is free to pour downward and outward through the bottom passages. Any one of the main tanks can be discharged completely in 4½ minutes. The time required to empty all the tanks depends upon how fast the deck hands work in opening the outlet valves in succession; but the entire operation can be carried out within half an hour. The purpose in backing the craft while discharging is to prevent the dirty water from being drawn inboard by the circulating pumps which obtain their water from outboard. To obviate the need of this maneuver and to prevent the foul water from reaching the circulating system of the engines, the pumps are now being arranged to draw their cooling water from tanks and a closed circuit within the ship. With the sludge dropped into the sea, the outlet valves are closed, and the vessel is ready to return to her base at Wards Island. The round trip of approximately 66 miles, exclusive of the time required for loading, takes about seven hours.

The present plan is to run two of the boats in maintaining continuous service between Wards Island and the sea and to hold the third as a standby. Later, when the capacity of the treatment works is increased, or when other projected activated-sludge plants are ready to operate, the present fleet will be amplified by the building of possibly identical ships. It is reported that the disposal of the sludge by means of these vessels entails an outlay of less than fifteen cents a ton—probably about one-seventh as much as would have to be spent if it were effected by other approved up-to-date methods.

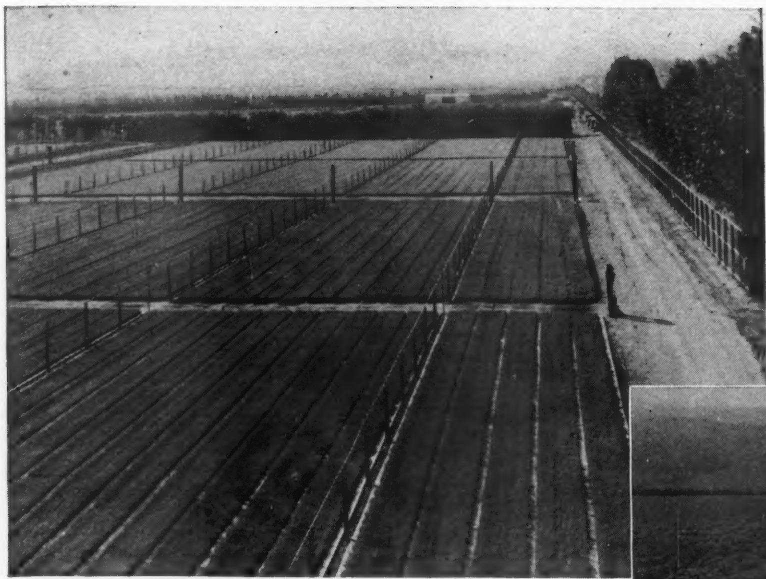
The Department of Sanitation has latterly been under the direction of William F. Carey, commissioner. Henceforth, however, the function of sanitation will be embraced by the more comprehensive executive organization known as the Department of Public Works, headed by Maj. Gen. E. M. Markham, formerly chief of engineers, U. S. Army. The construction of the Wards Island Sewage Treatment Works and of the three tributary sludge vessels—the *Wards Island*, *Tallmans Island*, and *Coney Island*—has been carried forward under the administration of Mayor F. H. LaGuardia.



Photo, Bureau of Sanitation, New York City

LOADING BOAT WITH SLUDGE

Showing the flexible 10-inch hose connections at the Wards Island wharf. The sludge consists of about 95 per cent water and 5 per cent solid matter and flows readily by gravity. A vessel can be fully loaded in about one hour.

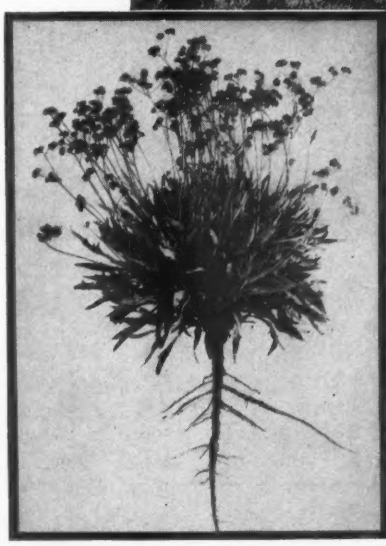


GROWING GUAYULE

The guayule resembles the sagebrush that thrives on the high plateaus of our western states. It attains a maximum height of 2 feet and, as the picture of the individual plant shows, acquires a long root that it sends deep into the ground to obtain moisture. As the guayule must be destroyed to extract its rubber, continual replanting is necessary to replenish the supply. The seed is gathered from mature plants and then sown in nursery beds, a group of which is shown at the left. After several months of growth, stimulated by regular irrigation, the seedlings are transplanted in fields. Four years are required to develop a rubber content high enough for profitable processing; but as this content progressively increases through the tenth year of growth, the time of harvesting depends on the demand for and market price of rubber. A field of mature guayule near Salinas, Calif., is seen below.

American-Grown Rubber

C. J. Greeves-Carpenter



WHEN general business conditions are good, the United States uses more rubber than the rest of the world combined. During the World War it consumed as much as 78 per cent of the total supply; but since then there has been a gradual decrease, and now the proportion is about one-half. With one car for every five persons in the United States, the manufacture of automobile tires alone accounts for 82 per cent of its rubber consumption.

The world production of crude rubber in 1937 was 1,135,082 long tons, according to the Statistical Bulletin of the International Rubber Regulation Committee. British Malay, with 469,960 tons, and the Netherlands East Indies, with 431,646 tons, together supplied about 81 per cent of the output. Other important producers were: Ceylon, 70,359 tons; British North Borneo, 13,213 tons; Sarawak, 25,922 tons; Siam, 35,551 tons; French Indo-China, 43,374 tons; and South America, 16,008 tons.

Today, we obtain rubber from three primary sources: *Hevea* trees, guayule plants, and the chemical laboratory. Ninety-eight per cent of the world's supply still comes from the *Hevea*, a native of the Amazon River Valley that has been transplanted to Malay and to other regions in the equatorial belt. Its rubber latex is confined in cells that are connected longitudinally; and the only function of the liquid, so far as the tree is concerned, seems to be to heal any wounds that the bark may receive. Taking advantage of this characteristic, the *Hevea* is deliberately gashed in order to gather the latex.

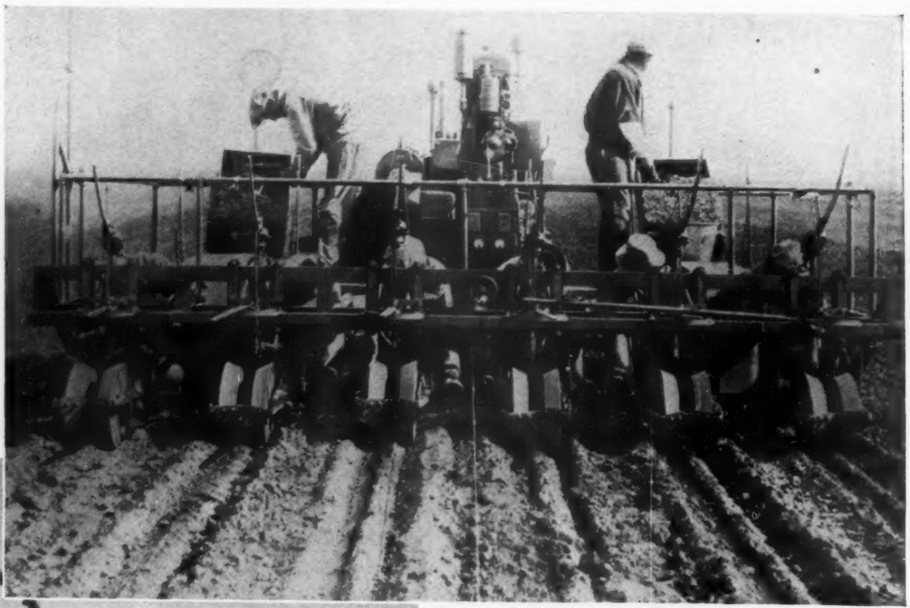
Production of rubber from the guayule, though still in its infancy, has progressed far enough to demonstrate that it could be increased to provide a large portion of our requirements in the event international hostilities interfered with importations of rubber from the present normal sources of supply. Aside from that important consideration, America needs a dependable source of home-grown rubber; and the guayule seems to offer a means of developing one with promising possibilities.

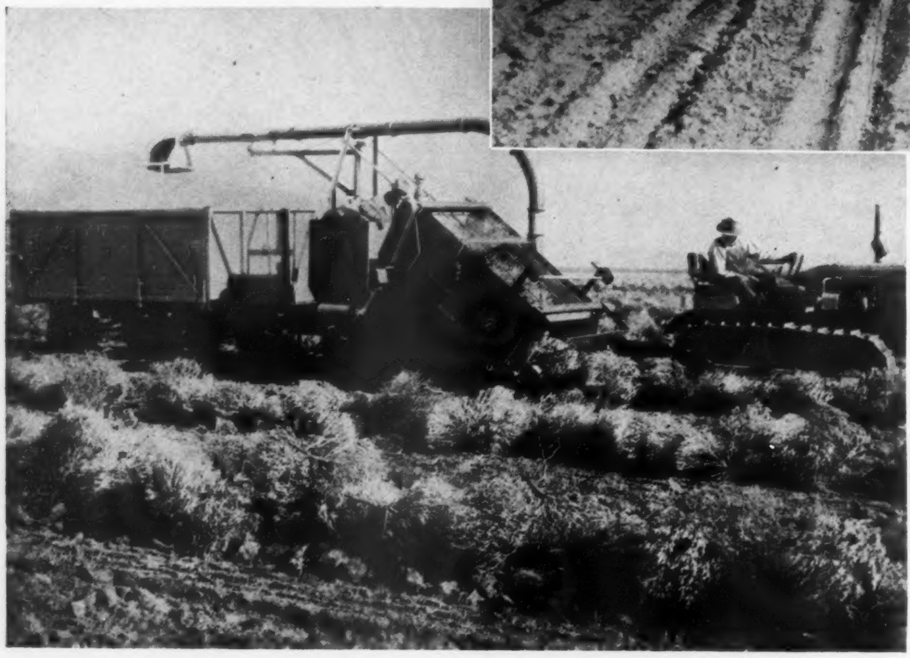
The guayule grows wild in the form of a bush on the high, arid plateau of Mexico that extends northward into the Big Bend area of Texas. Botanically, it is designated *Parthenium Argentatum*. It resembles the sagebrush of the western prairies, and seldom grows more than 2 feet high. Unlike *Hevea* trees, the guayule will withstand severe drought and heavy winter frosts. The Mexicans and Indians have been extracting rubber from it for several centuries; and in 1937, according to the U. S. Department of Commerce, Mexico produced 2,700 long tons of guayule rubber. All this came from wild, native plants that grew without cultivation.

In guayule plants, the contained rubber is stored as an aqueous solution in cells that are not connected, and, as a result, the liquid does not flow when the bark is cut through. Accordingly, the method of harvesting must of necessity differ from that practiced in the case of *Hevea* trees. There is a greater concentration of rubber than in the *Hevea* for the reason that the liquid is a source of resinous food supply to the guayule. The cortex of the plant contains as high as 35 per cent of pure rubber. Accompanying it are certain resins. There is a ready market for guayule rubber compounded with these resins; but they may be extracted to produce pure rubber, if that be desired. While it can be used satisfactorily in any of the numerous manufacturing processes in which *Hevea* rubber is employed, guayule rubber is especially suitable for coating or frictioning the cotton cords that are utilized in building up tire casings. It can also be used to advantage

FIELD OPERATIONS

Much special machinery has been developed to expedite the planting, cultivating, and harvesting of guayule. At the right is a tractor-drawn seedling planter that has a capacity of 130,000 shrubs a day. Notice that there are working stations for six men who place the seedlings in the ground. The rows are spaced 28 inches apart, and special cultivating machinery covers six at a time. The first step in harvesting is accomplished with a digging machine that uproots two rows of plants simultaneously and piles them in one windrow. After they have dried, the plants are picked up by the harvester shown below. It chops them into pieces and blows them through the tube into the truck.





as a plasticizer of tire-tread stock and for making inner tubes.

In its native state, the guayule plant is dormant during the dry season but flowers vigorously after the first rains, producing upwards of 100 seeds to the shrub. Under desert conditions, only a few of these survive. Many of them fall to the ground beneath the mother plant; but the deeply entrenched roots of the latter absorb so much moisture that the young seedlings soon shrivel and die. Some seeds are carried away by the wind or by other agencies, and if they happen to fall on ground devoid of plant life they have a fair chance of growing to maturity.

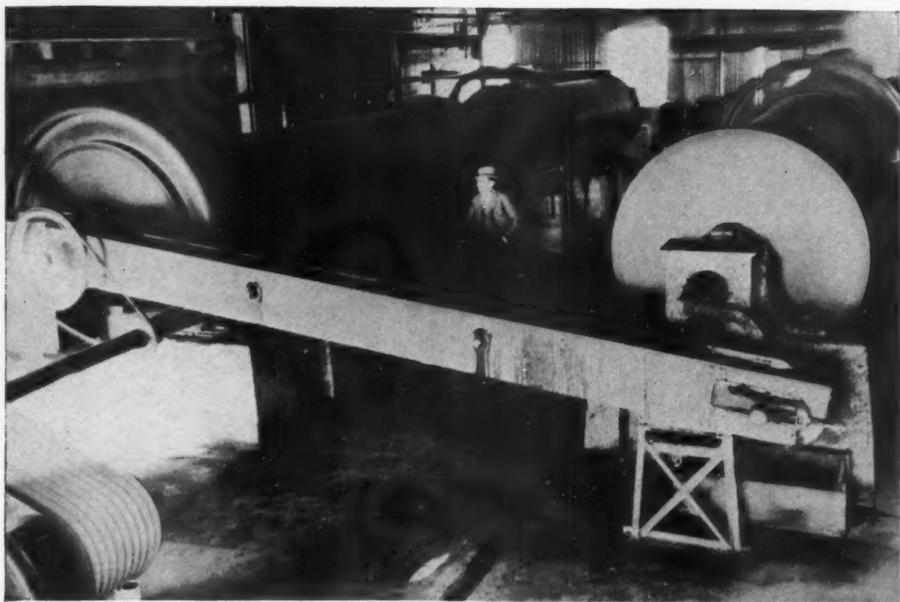
About twenty years ago, G. H. Carnahan, of New York City, conceived the idea of domesticating the guayule shrub for the purpose of producing rubber. He formed the Intercontinental Rubber Company and became its president. The first step was to conduct tests to determine what varieties would yield the greatest amount of rubber per plant. Since that time, Intercontinental's chief botanist, Dr. W. B. McCallum, has selected and isolated six or seven of the hundreds of strains of guayule that grow wild. All these can be raised from seed; and they are high in rubber content because the rubber is distributed throughout the cortex covering the roots, stems, and branches. Four-year-old plants actually produce from 14 to 16 per cent of their weight in pure rubber, computed on a bone-dry basis.

The program of domesticating the species of the wild plants that offered the most promising commercial possibilities was started in Mexico and carried on by an associate concern—the Mexican Rubber Company—that had been organized in 1904. Three factories, with a combined annual capacity of approximately 3,600 tons of dry, finished products, were put in operation. Political unrest in Mexico led to the transfer of the developmental work to the United States. Initially, efforts were concentrated on the wild guayule plants in Texas; but as the quantity available in that region was inadequate, some 400 acres of land in San Diego County, California, were placed under cultivation. It was soon discovered that climatic conditions there were not favorable to guayule culture, so activities were shifted to Arizona. There, again, only partial success was achieved, and another move was made—this time to various valleys in central California. All the while, special machinery for harvesting and processing the shrub was being devised or improved upon.

In February of 1931, the American Rubber Producers, Inc., a subsidiary of the Intercontinental Rubber Company, opened a factory that had been built at a cost of $150,000 for the treatment of guayule plants raised near Salinas, Calif. It has a daily capacity of 12,000 pounds of dry-weight rubber, and embodies all the best features of the earlier Mexican establishments, as well as some improvements. Similarly, methods and equipment for gathering the guayule in the fields also have undergone further development. At the time the factory began to operate there were available only 800 acres with shrubs that were sufficiently mature for processing; but by 1937 the acreage had been increased to 2,000, and the plants growing thereon numbered something like 15,000,000.

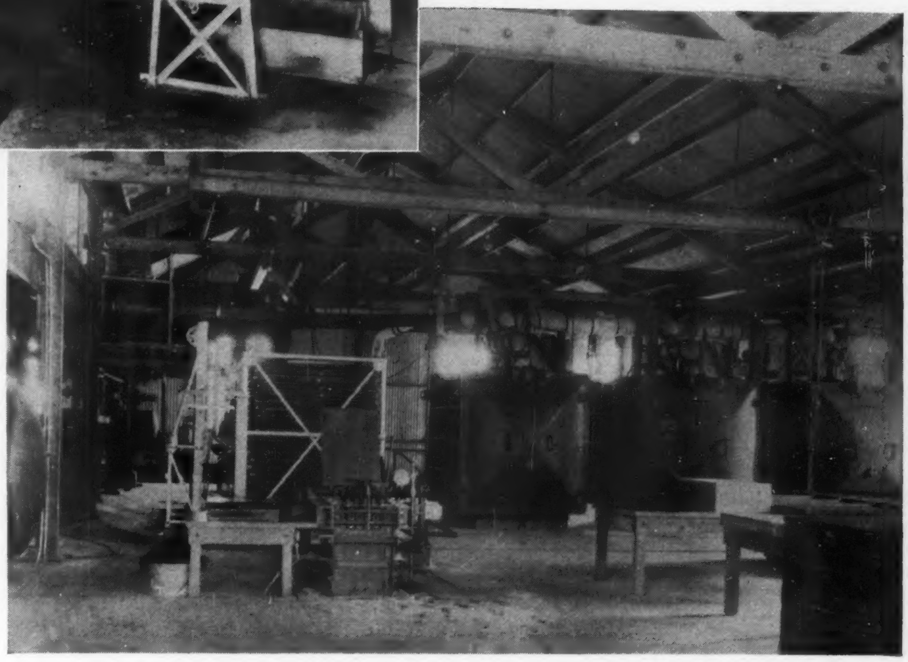
The seed is specially prepared to insure germination, and is sown during April and May in nursery beds. Each bed is 4 feet wide and 180 feet long, and will provide 24,000 seedlings, or enough for three acres of land. The ripened seed used for sowing is collected from plants in the field by a vacuum type of machine. Mounted on a light truck, it passes along the rows, gathering sufficient seed in one day for 100 acres. A special tractor-drawn seeder plants 100 beds in four hours. During the summer the guayules are irrigated by a sprinkler system, and three men can take care of 100 beds.

For two years after the seedlings are transplanted in fields, it is necessary only to keep them free from weeds, and this is accomplished with a 6-row cultivator which can, with but one operator in attendance, cover five acres in an hour. By the early part of the third year the shrubs are high



EXTRACTING THE RUBBER

Mature guayules contain up to 16 per cent of rubber by dry weight. This is extracted by grinding the plant material into a pulp, by water-logging the woody fiber to precipitate it, and by floating off the rubber. In the picture at the left are some of the ball mills in the factory at Salinas, Calif. As separated, the rubber contains about 45 per cent moisture. It is dehydrated in vacuum-type driers. Two of these are shown at the right in the view below. On their left is a rack loaded with shallow pans of rubber ready for one of the drying units.



enough to shade out weeds, and further cultivation is unnecessary.

After four years of growth, the rubber content of the guayule is sufficient to make harvesting profitable; but the yield per pound of plant increases up to and through the tenth year. Accordingly, harvesting takes place anywhere between the fourth and tenth years, depending upon the demand for rubber. A special machine that uproots the shrubs to a depth of 10 inches digs up two rows at a time and piles them in one windrow. During this handling, the plants are beaten mechanically so as to remove substantially all the soil from their roots. The windrows are left in the field for drying, and during this period the moisture content of the guayule drops from 40 per cent to 20 per cent.

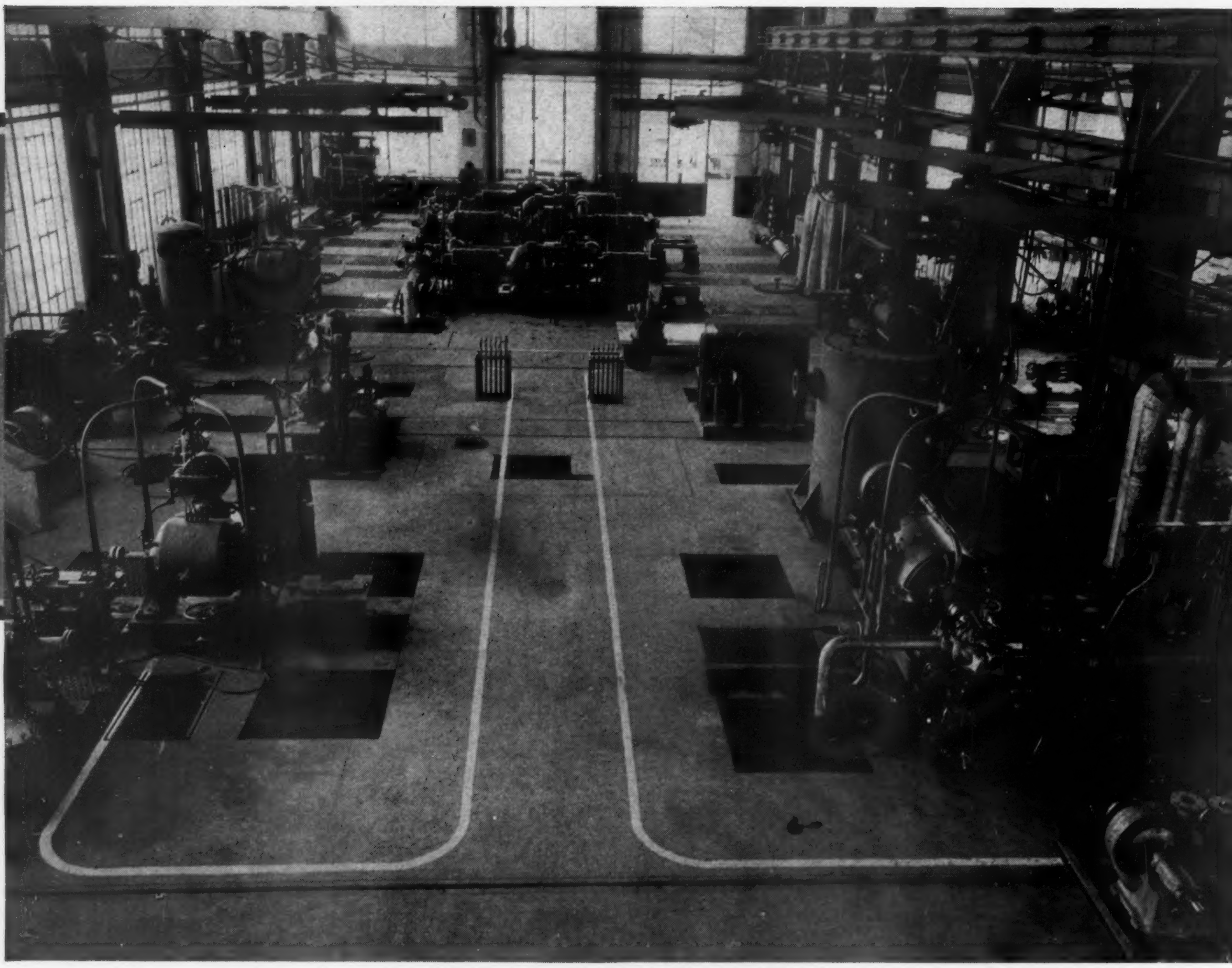
After examination has shown the plants to be adequately dry, a tractor-drawn harvester picks them up and chops them into ½-inch lengths, which are loaded by drafts of air into trucks that move along with the machine. In this form, the raw material is delivered to storage bins at the factory. From there, screw conveyors carry it to the first processing operation at the rate of 4,000 pounds, dry weight, an hour—blowers located near the bins removing virtually all the dust from the dry mass. Automatically and continuously it is fed to 4 x 2-foot macerating rolls from which the crushed material passes to a set of four 5 x 22-foot, silex-lined tube mills connected in series and containing flint pebbles, about 2½ inches in diameter, which assist in the grinding operation. In the first of the tube mills water is added in the proportion of six parts of water to one of pulp. There the woody fiber becomes water-logged, and the minute shreds of rubber that are liberated ball up into small particles.

From the final tube mill the pulp goes over a screen through which the slimes pass while the residue is delivered to a mixer in which it is diluted with fresh water at a temperature of 100°F., the proportion being 10-12 parts water to one of pulp. The material is then fed to a separation tank in which the rubber bark and lighter fibers float and are automatically skimmed off. The water-logged woody structure settles and is withdrawn from the bottom of the tank. The fiber, cork, and rubber that are continuously skimmed off go to a 4 x 12-foot-high hydraulic chamber into which water is forced under 350 pounds pressure. This serves to water-log any remaining non-rubber material which sinks, while the almost pure rubber floats and is skimmed off and conveyed to a ball mill. Still in the form of balls about the size of tiny seeds, the rubber is thoroughly scoured in the ball mill by small flint pebbles to get rid of all traces of dirt. As the heavier material precipitated in the pressure chamber contains small amounts of rubber, it is recirculated, entering the system between the second and third tube mills previously described.

The pure rubber from the ball mill is put in a settling tank, charged with water, in which the rubber agglomerate floats while any dirt settles to the bottom. Next the rubber is passed through a wringer and then to a horizontal, rotating drum which breaks up the cake or sheet formed in the wringing process. At this stage the rubber still contains about 45 per cent moisture. To remove this, the rubber is placed in shallow metal trays holding about 35 pounds each, dry weight, and run through a vacuum-type drier in racks holding 22 trays each. The passage through the drier requires several hours; and as the rubber emerges from the discharge end it contains about 1 per cent moisture and is of sponge-like consistency.

The final operation consists of forming the rubber into blocks, 3 x 2 x 1 foot in dimensions, in a hydraulic press where it is subjected to a pressure of 2,500 pounds per square inch. These blocks fit exactly into the wooden cases in which the product is shipped to buyers.

As conditions warrant, it is possible that a more extensive acreage will be given over to the cultivation of the guayule, which may, perhaps, be the means of making the United States independent of foreign rubber-producing countries, if not a factor in the world's supply.



GENERAL VIEW OF LABORATORY

In the foreground are the electrical dynamometers. A pump is set up for testing on the one at the right, with the nest of Venturi meters at the extreme edge of the picture. One of the two rail lines that transport heavy pumps into the laboratory is visible at the bottom with part of a car in the lower right-hand corner. A second car is in the right middle ground. Some of the eleven air hoists that assist in handling material are seen mounted on boom cranes extending out from the building columns. An overhead traveling crane takes care of heavy loads. The three steam-turbine dynamometer stands for testing large pumps are at the top center. Beneath the entire floor area shown is a double-walled, concrete reservoir containing 400,000 gallons of water. The uppermost part of the factory (top of opposite page) houses the assembly department to which material flows from the shops at the left. All the right-hand section of the building with the sloping roof is given over to the testing laboratory. It is approximately 150 feet long and 75 feet wide. The laboratory was designed as an integral part of the structure when it was erected about ten years ago. At the extreme right are the offices.

THE PUMP is probably the nearest approach to a universally used machine. It is claimed to have been the first mechanical device developed by mankind; and in China, as well as in other parts of the world, manually operated pumps that differ but little from those used many centuries ago are still relied upon to elevate water from streams or lakes for irrigating crops. As civilization advanced, better pumps were developed; and with the progressive modernization of industrial methods came outstanding improvements in pumping equipment.

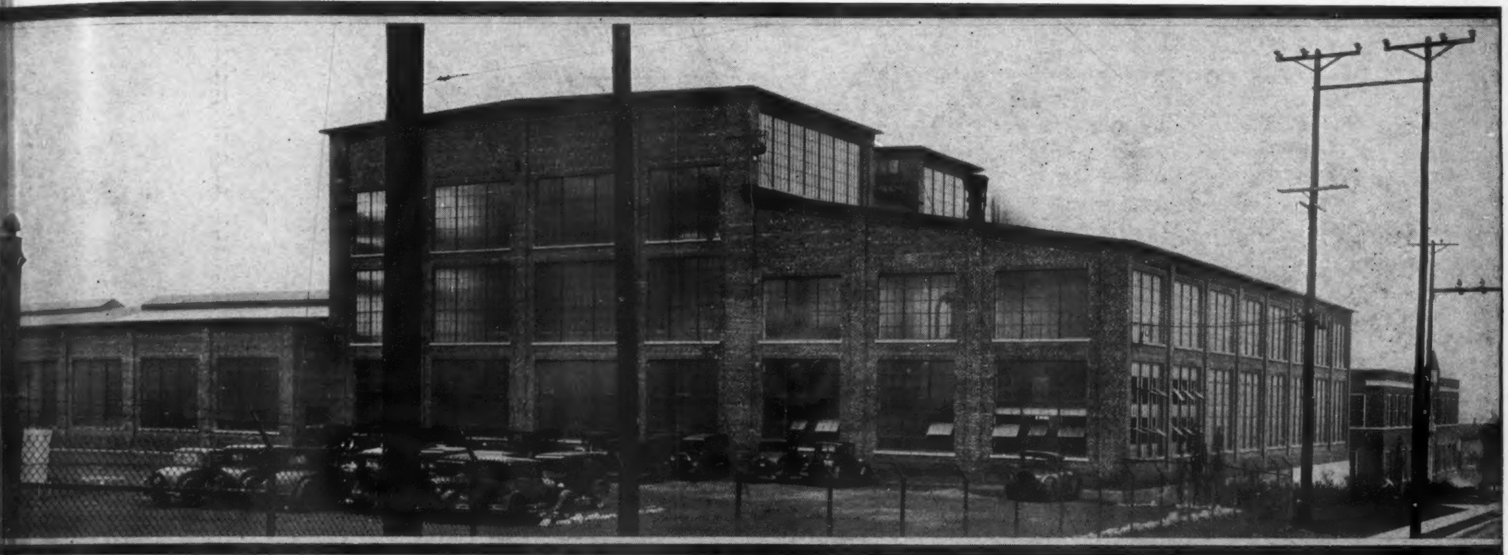
It would be difficult now to find an industrial plant of considerable size that does not make use of pumps. For that matter, the smoothness with which our daily lives flow is dependent in large measure on this type of mechanism. Our water, milk, and virtually every liquid that enters into our diet are all pumped one or more times before they reach our tables. The clothes we wear, the daily papers and magazines we read, the steel and bricks and lumber that go into our homes and offices, and the electricity that lights them, all require the services of pumps in their making.

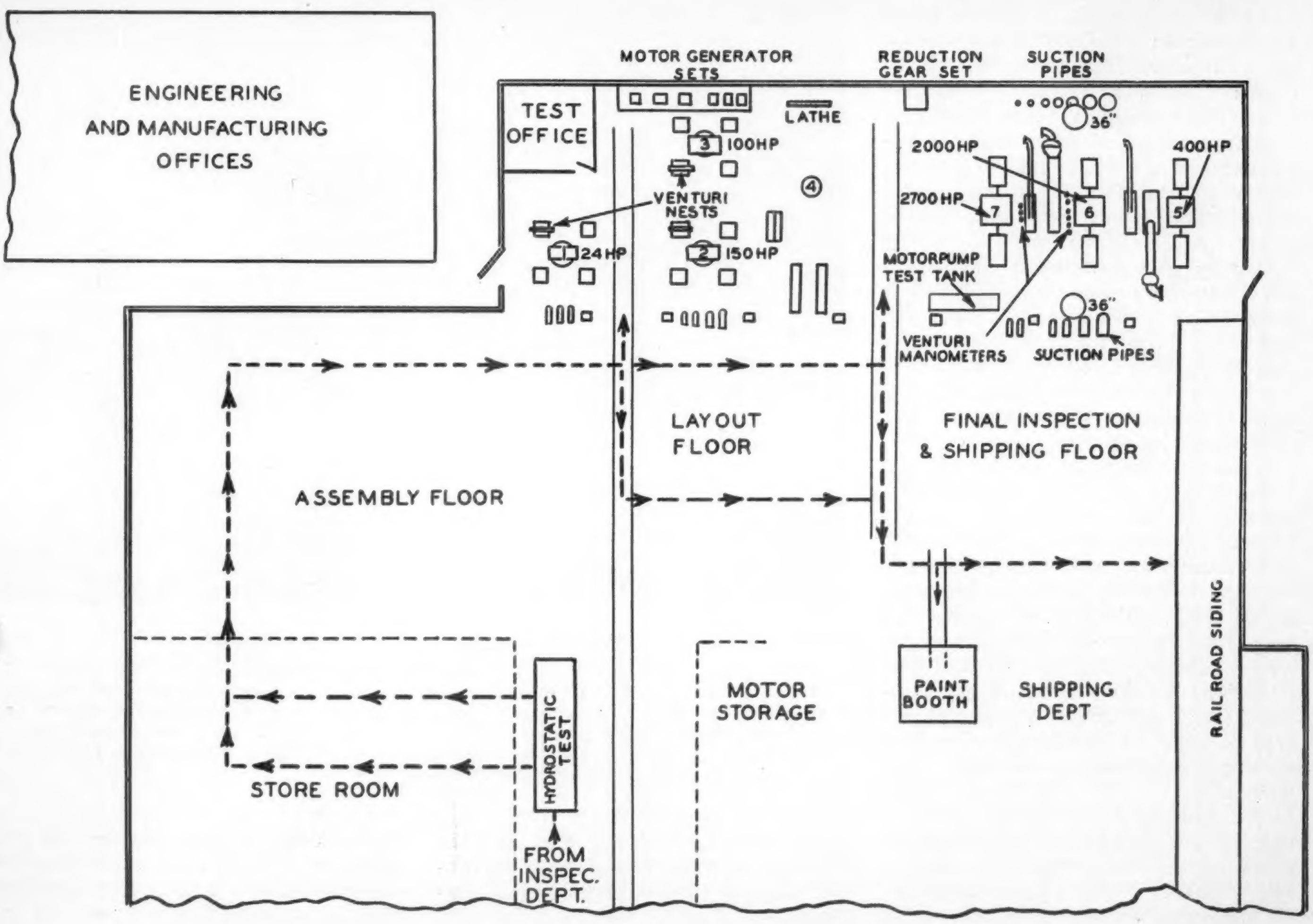
Unseen, and failing so rarely that we are seldom reminded of their presence, pumps, by reason of their essential functions, contribute daily to our comfort and pleasure. All the while we are riding in an automobile a pump is circulating cooling water around the engine to keep it running smoothly. When we stop for gasoline, it is a pump that lifts the fuel from an underground tank into the receptacle at the rear of the car. Many other pumps dealt with the gasoline before it reached the filling station. The crude oil from which it was derived was pumped through a pipe line or into a tanker that delivered it to a refinery. There, other pumps moved it through the refining processes and thence into tank cars, from which it was pumped, in turn, into tank trucks. There is no limit to which we can carry this simple illustration, for the oil well which yielded the petroleum was drilled with the aid of a pump that circulated mud in the hole; and that pump was made in a factory where other pumps supplied water to boilers and performed additional essential services.

Thomas's Register of American Manufacturers for 1938 lists 381 pump manufacturers. All together they make every conceivable kind of pumping appliance. Presentation of the full list, broken down into the multitude of classifications, requires 53 pages of this large-sized directory. It is impossible even to estimate the annual production of pumps, save to say that it

How Modern Pumps are Tested

J. W. McConaghy





GENERAL LAYOUT DRAWING

The testing laboratory is at one end of the main manufacturing building, adjacent to the assembly and shipping departments. Coming from the inspection department (bottom of drawing), pump casings are given a hydrostatic test and then go either to the store room or direct to the assembly floor where pumps are made up complete except for their drivers and base plates. They are then transported by truck or rail car to the proper testing units in the laboratory. Following the test, they are moved to the layout floor, where each unit is assembled with its driver on a bedplate. After final inspection, pumps are painted, crated, and loaded on cars for shipment. Nos. 1, 2, and 3 indicate the positions of the electric dynamometer stands; Nos. 5, 6, and 7 those of the steam-driven stands; and No. 4 shows where provision has been made for a projected unit. The Motorpump test tank is in the right lower section of the laboratory.

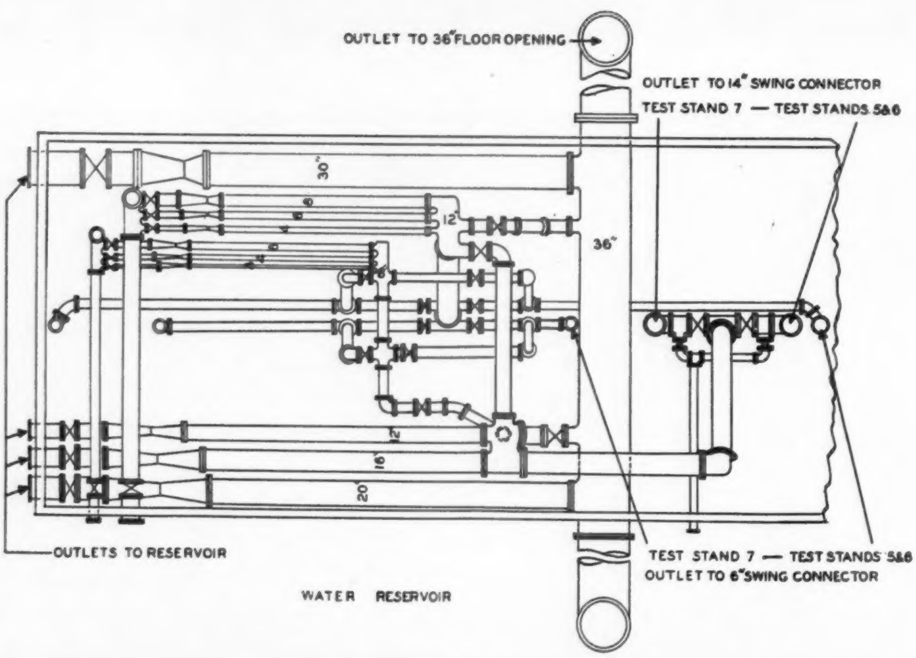
runs into millions of units. It would take much space merely to enumerate the different types, since the services they perform are so varied as to call for a wide range of structural designs and sizes.

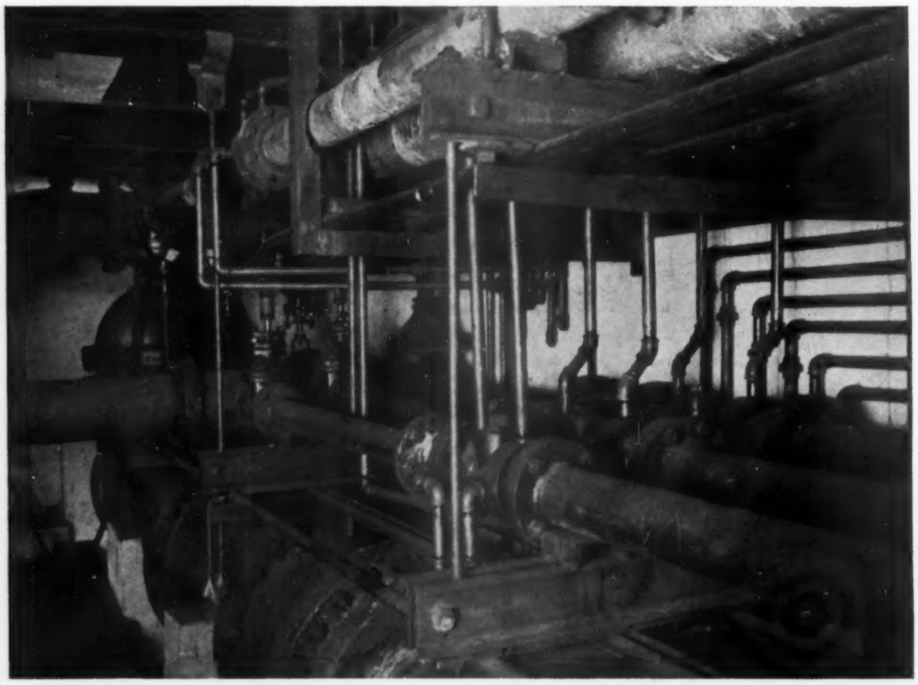
During the past few decades there has been a continual and persistent demand for higher-quality pumps. The trend in countless industries has been towards the handling of fluids in greater volumes and at higher pressures. To meet this demand, American pump manufacturers have spent vast sums in research to improve designs and, consequently, performance. The old-style piston pump is still adequate for many applications, but for numerous others it is wholly unsuitable. In its place has appeared the centrifugal pump, which, in its higher form of development, is truly an aristocrat in the machinery world.

For nearly three-quarters of a century, Cameron pumps have given dependable service in mines and industrial plants. Cameron sinking pumps have aided in putting down some of the largest and deepest shafts ever sunk into the earth's crust in the quest of minerals. What was originally the A. S. Cameron Steam Pump Works has for many years been an integral part of Ingersoll-Rand Company, and the pumps are now sold under the latter's name. Piston pumps, which were once the only type manufactured, remain an important part of the line, but the great expansion in operations during recent years is attributable chiefly to the development of high-class centrifugal pumps.

Step by step, refinements and betterments have been made to meet industry's demands for higher-quality pumps, and there have been concurrent increases in sizes and capacities. Present-day standard pumps have from one to twenty stages or more, depending upon the pumping head to be served; range from ¼ hp. to 2,500 hp.; and have discharge openings up to 54 inches in diameter. They are made for handling almost any liquid or viscous material capable of being pumped, ranging in consistency from the lighter hydrocarbons to paper stock, and at temperatures up to 700°F. Materials of construction vary with the service—special high-strength casings being furnished to withstand high pressures, and rotating elements of selected metals where it is necessary to prevent corrosion or to resist abrasion from suspended solid matter in the liquid being pumped.

An important phase of pump manufacture is testing. Pumps of the better class are guaranteed to meet certain performance specifications. The pump user rarely has facilities for conducting an actual test, and accordingly accepts the data submitted by the manufacturer. Where a pump order amounts to a considerable sum, or where the pump or pumps are to be used under exacting service conditions, the buyer frequently chooses to send a staff engineer to the pump-maker's factory to witness the tests. In any event, the scope and character of the manufacturer's facilities, and the thoroughness with which the tests are conducted, are of vital importance to the purchaser.



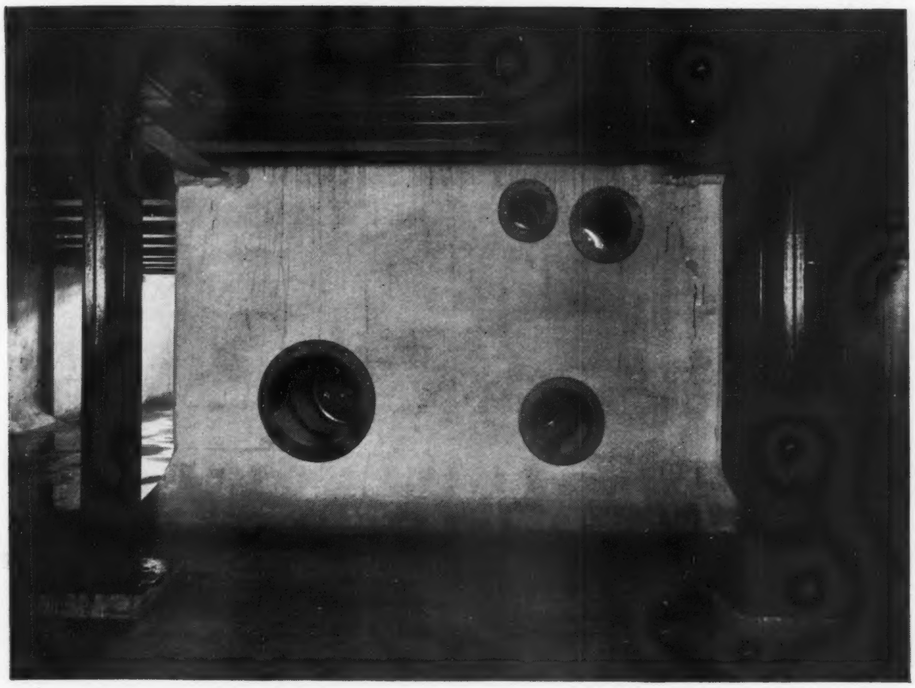


ARRANGEMENT OF VENTURI TUBES

The Venturi tubes used with the steam-driven equipment, as well as the steam supply and exhaust lines that serve the turbines, are located in a dry gallery that extends down the center of the water reservoir. The drawing shows the arrangement of the Venturi tubes and the locations of the connections to them. The tubes are divided into three groups with a capacity range of from 0 to 70,000 gpm. The photograph gives a partial view of the piping in the gallery.

A relatively small difference in the efficiency of a pump means a considerably higher power bill. To illustrate this, let us assume that an industrial plant uses a 200-hp. boiler feed pump. This is a fair example, as there are hundreds of establishments that have pumping units of this size or larger. At the rate of two cents a kilowatt-hour for power, and with a motor efficiency of 90 per cent, the electrical energy needed to operate the pump sixteen hours a day and 300 days a year will cost approximately $16,000. A variation of 5 per cent in operating efficiency will increase the annual power bill by $800.

Recognizing that the responsibility for producing high-quality machinery that will live up to the claims made for it rests with the manufacturer, Ingersoll-Rand Company maintains a pump-testing laboratory



WATER RESERVOIR

A partial view of the 9-foot-deep reservoir beneath the laboratory that holds 400,000 gallons of water. It is of double-wall, concrete construction, and its top forms the floor on which all the testing is carried on. This picture shows one end of the dry gallery in which are located the Venturi tubes and steam lines of the turbine-driven dynamometer stands. The openings are for the discharge lines of the 30-, 20-, 16-, and 12-inch Venturi tubes.

that is said to excel any similar establishment run by a pump-making concern. There pumps are tested as a routine part of the manufacturing procedure. The laboratory represents aggregate expenditures of $350,000—a sum that is greater than the total cost of many a pump factory. It has been in successful use for nearly ten years. As there was little in the way of precedent to follow, particularly on a scale large enough to be of service, the general arrangement and much of the equipment were designed by the company's own technical staff. As a result of the careful preliminary study that was given the project, the laboratory functioned smoothly and adequately from the start; and during the intervening years it has been found necessary to make only very minor changes. Continued use of the facilities has, naturally, suggested numerous refinements of procedure and equipment, and these have been promptly incorporated.

A thorough check of the performance of a pump while it is operating at full speed and capacity constitutes the final step in the manufacturing sequence. If this test is conducted properly, the purchaser has the assurance that the unit is mechanically and hydraulically up to standard. To obtain reasonable accuracy, a fairly complete set of test instruments is required to cover the full line. The magnitude of the problem is apparent when it is pointed out that the Ingersoll-Rand test laboratory is capable of delivering and measuring power from ¼ hp. to 2,700 hp. at rotative speeds from 100 to 6,500 rpm., and of producing and measuring discharge quantities up to 70,000 gpm. and heads up to 8,000 feet. The manner of accomplishing these things can perhaps be presented best by a description of the laboratory.

Because of its low cost and cleanliness, water is a desirable test medium. A suitable reservoir to hold it is necessary, and this is in the form of a huge, double-walled, rectangular concrete pit which might make an admirable swimming pool were it not for its concrete top that serves as a working floor and on which all the power-producing and measuring equipment is located. The outer walls of the pit are 12 inches thick and doubly reinforced: the inner walls are also made up of 12 inches of reinforced concrete. The interior of the pit is lined with seven layers of waterproofing material separated by layers of asphalt. After ten years of service, the pit remains free from leaks. The walls are of cantilever construction and, though they receive some support from the building walls, it is believed that the pit would carry its water load on the inside or resist the ground pressure from the outside without the aid of any other structure.

The reservoir is approximately 150 feet long, 75 feet wide, and 9 feet deep, save in one 30x18-foot area where it has an extreme depth of 25 feet. The deeper well is used whenever a high suction lift on pumps is desired. The reservoir holds about 400,000 gallons of water, a substantial volume that has two great advantages: first, it can absorb a considerable amount of energy without a marked rise in temperature—a factor that must be considered when pumps requiring 2,000 hp. and more are being tested; and, second, even though the water is being circulated continuously, the distances between suction and discharge pipes can be made great enough to prevent appreciable disturbance and thus permit steady observations to be taken.

In addition to the pit, it is necessary, of course, to provide suitable equipment wherewith to obtain the usual measurements of pump performance. These measurements are: quantity or pumping capacity per unit of time; pressure or head; horse power required; and revolutions per minute. In the Ingersoll-Rand laboratory, the quantity is measured almost exclusively by Venturi meters, the pressure by mercury manometers or Bourdon tube gauges, the horse power by cradle or torsional dynamometers, and the revolutions per minute by speed counters and a synchroscope.

Pumps requiring less than 150 hp. are usually tested with electrically driven equipment. This is located at one end of the laboratory and includes three cradle-type, direct-current, variable-speed dynamometers of 24, 100, and 150 hp., respectively. Each dynamometer is mounted on a vertical plunger which can be raised or lowered by compressed air to facilitate aligning the dynamometer and pump for coupling them together. To eliminate the use of shims under pumps for their exact alignment, a micrometer screw is provided that permits making fine vertical adjustments of the dynamometer. The table on which each dynamometer is mounted is free to turn radially and can, accordingly, be used in any one of four positions, which are 90° apart. This feature makes it unnecessary to disturb a pump that has been set up for testing, as the dynamometer can, meanwhile, be turned to another position for conducting other tests. It is set in any one of the four positions by a dowel pin and, after vertical adjustment, is locked with a bellyband.

Simply stated, the cradle dynamometer measures the torque applied to a rotating shaft. The torque multiplied by the angular velocity gives the horse-power input. The angular velocity is measured by the revolutions per minute. In this case, the dynamometers are equipped with Toledo scales on which the torque reaction is read directly in pounds. The well-known Ward Leonard variable voltage system is used for speed control. The control panels are equipped with two rheostats, one in the generator field circuit to control the voltage on the dynamometer armature, and the other in the dynamometer field circuit. This eliminates the need of other starting equipment and assures excellent speed control. Direct-reading tachometers, or speed indicators, are located on the control panels. Two dual-generator, synchronous-motor generator sets convert alternating current to direct current for the dynamometers. Of the four generators thus provided, three supply power to the dynamometers and the fourth one furnishes the

field excitation for all three of the units.

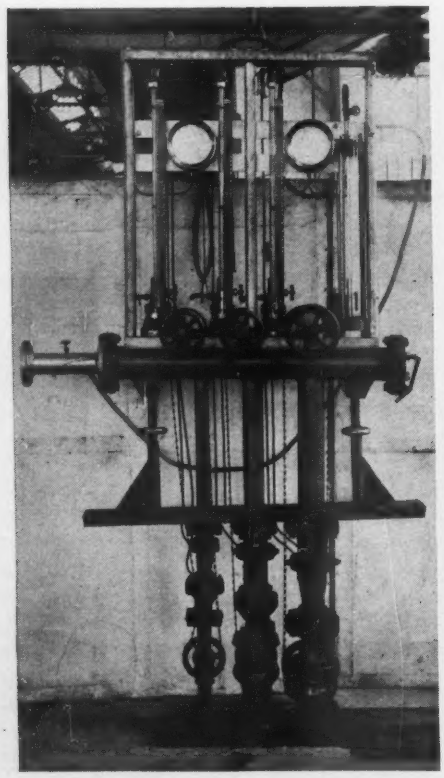
Pumping capacities are determined by Venturi meter sets, which are made up in nests of three tubes each. The capacity of the smallest tube is one-third that of the next larger one which, in turn, has a capacity one-third that of the largest tube. This arrangement was necessary because of the small differential pressures encountered when a Venturi tube is operating at less than one-third its rated capacity. The tubes are set up vertically in a row and receive their flow from a horizontal header. There is sufficient length of straight pipe in front of each Venturi to compensate for any disturbance in flow. A valve at the discharge of each tube affords the test engineer a means of throttling and therefore of varying the capacity of the pump being tested. The tubes may be used in parallel, in which case the volume flowing through the nest is the sum of the three Venturi readings. Special connecting pieces are provided between the meters and the pump. Each dynamometer has its own set of connections and discharge pipes. The meter nest also carries a suction manometer and discharge gauges.

The equipment just described takes care of pumps requiring between 2 and 150 hp. Driving motors of pumps of less than 2 hp. are calibrated by a small brake which is used in conjunction with suitable electrical instruments. Capacities of less than 10 gpm. are determined by displacement, or by weight measurement against time.

In the usual test routine, a pump is set on the stand and lined up with a dynamometer. The suction pipe and Venturi nests are connected, the throttling valve is opened slightly, and the pump is primed by inducing suction by means of an air ejector. The pump is then started and, if it seems to be functioning properly, is brought up to operating speed. With the speed held constant, observations are made of the torque reaction, suction lift, discharge pressure, and flow. If the mechanical performance of the pump is satisfactory, and calculation of the data just taken shows that it has met its hydraulic guarantees, it is moved from the test stand to the assembly floor, where it is aligned with its driver on a bedplate. After a final inspection, it is painted and crated for shipment. Incidentally, as an accompanying sketch shows, the test laboratory is located adjacent to the assembly bay of the factory, thereby shortening as much as possible the movement of the pumps. Hauling is done by means of two rail and truck systems, one at each end, which carry, respectively, small and large units. In the laboratory, an overhead traveling crane and eleven air-operated hoists, mounted on auxiliary boom cranes extending from the steel building columns, take care of all the necessary handling.

Pumps requiring more than 150 hp. are tested in a generally similar manner but with different equipment, which is located in the end of the laboratory opposite to the smaller pump stands. The steam turbine with throttle-control is probably the most convenient means of obtaining large amounts of power at variable speeds, and has accordingly been adopted for this laboratory. The range from 150 to 2,700 hp. is covered by three turbines having respective capacities of 400, 2,000, and 2,700 hp. As they are unidirectional, they are fitted with extensions on both ends, and this makes it possible to test pumps designed for either direction of rotation.

The pumps' power input is determined by means of torsional transmission dynamometers, and as there are three double-ended turbines, six of these units are available. This form of dynamometer measures the torque transmitted from the turbine to the pump and, as in the case of the cradle dynamometer, the horse power is the torque multiplied by the angular velocity. In essence, it consists of a set of telescoping sleeves, mounted in bearings, with couplings on each end. Disks are mounted on these sleeves in such a manner that the angular displacement of the couplings can be read. The torsional member that transmits the torque extends through the tubes. It is calibrated by a lever arm and weights to give torque versus scale readings at the disks. When the whole assembly is rotating, the stroboscopic effect makes it possible to read the scale. The torsional member is arranged so that the one-third, two-third, or full torque capacity can be determined without the need of removing the

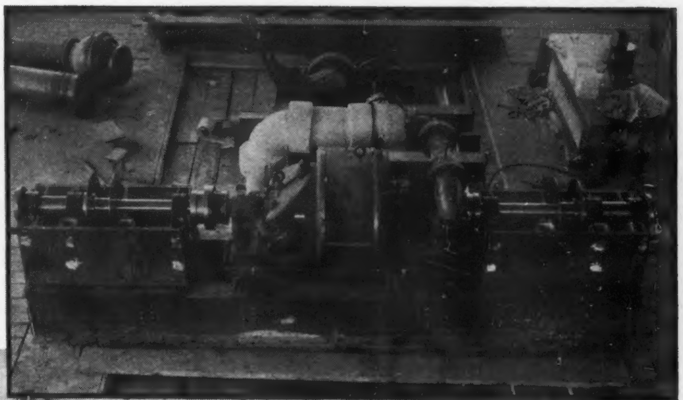


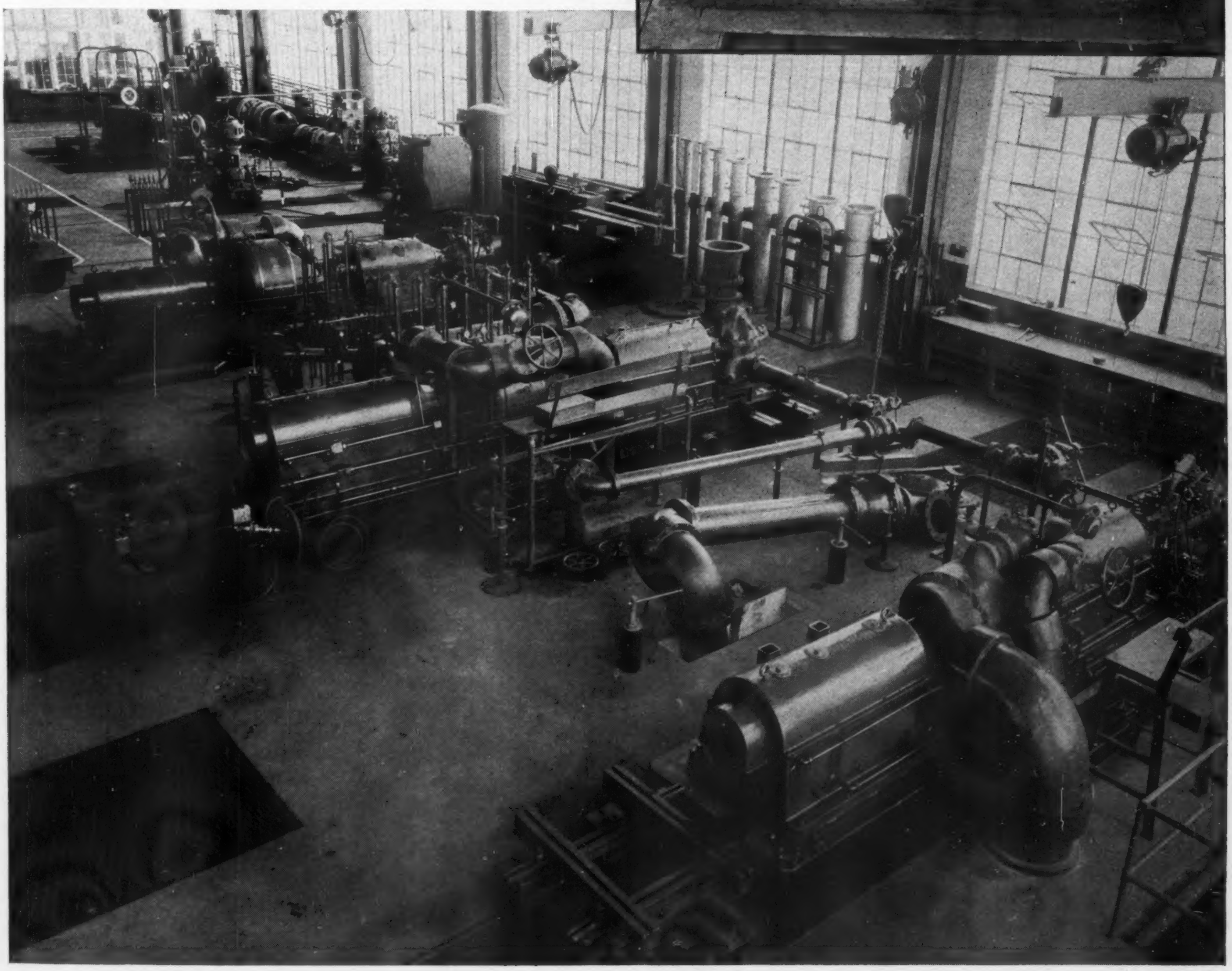
VENTURI TUBES AND MANOMETERS

At the left is the complete equipment used for measuring pump capacities in connection with the 24-hp. electric dynamometer, the smallest of the stands. Included are the Venturi tubes and their manometers, suction manometer, discharge valves, and discharge gauges. The Venturi tubes may be employed individually or in parallel. The picture at the right shows seven of the ten manometers used with the Venturi nests of the steam-driven test stands.

STEAM-DRIVEN DYNAMOMETERS

The large picture shows the steam-turbine-driven dynamometer stands. From left to right their respective capacities are 400, 2,000, and 2,700 hp. A pump is mounted for test on the right-hand end of each unit, and at the left ends is pictured the manner in which foundations for pumps are built up of parallels to obtain the desired height for alignment with the dynamometers. Along the wall at the top right are the suction pipes of varying sizes used with different pumps, and near the upper left-hand corner are the motor-generator sets that supply direct current for the electric dynamometers. In the inset is the 2,000-hp. turbine with the covers removed from the dynamometers mounted on either end.

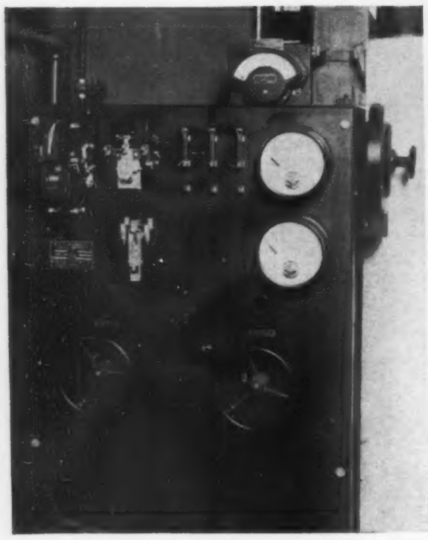




pump from the stand, as would be the case with a standard Amsler dynamometer.

The steam supply and exhaust lines for the turbines are located in a dry gallery extending down the center of the pit. This gallery also contains the Venturi tubes used with the steam-driven equipment. The layout of the Venturi tubes is shown in an accompanying sketch. They are divided into three groups, according to capacity: 0 to 3,600 gpm.; 1,000 to 14,000 gpm.; and 8,000 to 70,000 gpm. The first group is connected with the pump on test by 6-inch flexible pipes, the second by 14-inch flexible pipes, and the third by a connector and a 36-inch header. The third group is usually used in conjunction with the central one of the three turbines, the 2,000-hp. unit. The same scheme of proportioning the tube capacities is practiced in the case of these Venturi meters as was described in connection with the portable Venturi tube nests in the electrically driven equipment. As the general layout sketch shows, the arrangement of the turbines is such that both the 2,000-hp. and 2,700-hp. units are served by one 6-inch and one 14-inch swing pipe, while a similar set of pipes serves the 400-hp. unit. Suitable valving is provided to connect the desired Venturi tube with the pump being tested. There is sufficient straight pipe on the upstream side of each Venturi to eliminate disturbance. Inasmuch as the maximum permissible pressure on the metering equipment is 100 pounds per square inch, a throttling valve is placed at the pump when testing pumps that generate higher pressures. A secondary valve on the downstream side of the Venturi tubes provides a means of keeping the meter system under positive pressure. Connection between the pump and the throttling valve is established by flanged spools. Suction pipes of various standard sizes are available for making ready connections with the pumps.

As the dynamometers are permanently installed, it is necessary to align the pumps with them. To do this a foundation of parallels is made with structural members. One set of these parallels is adjustable, and



DYNAMOMETER AND CONTROL PANEL

Above is the 24-hp. electric cradle-type dynamometer. The air-operated plunger on which it is mounted has been raised, and the dynamometer is being turned to show how it can be used in any one of four test positions spaced 90° apart. Torque reaction is read directly in pounds on the scale above the unit. At the right of the dynamometer is the group of manometers that indicates the flow through the Venturi tubes beneath the floor. The picture at the left shows the control panel for this dynamometer. It permits varying the dynamometer speed through a range of from 200 to 3,600 rpm.

smaller pumps can be brought into exact alignment by this means, while shims are used to make the final adjustment in the case of larger, heavier pumps.

Obviously, the coupling problem was one that required serious consideration because the shaft sizes vary from ¾ inch to 5 inches. With the electrically driven equipment there is a standard pump half coupling of the pin-and-buffer type for each shaft size. A special ring on the dynamometer coupling carries the pins and is arranged so that it can be slid axially to engage the coupling on the pump or be withdrawn sufficiently to disengage the pump from the dynamometer. The steam-driven equipment needs heavier couplings, and is provided with a special pump half coupling that can be used with the aid of tapered adapters for shafts of different sizes. This coupling has a ring-and-pin device akin to that serving the electrical dynamometers.

The turbines have maximum operating speeds of 4,000 rpm., but higher pump speeds are obtained by using step-up gear. With the available equipment it is possible to test at 6,500 rpm. up to 1,000 hp. Reversing the procedure, reduction gear is used when pumps require considerable power at low speeds. This permits operating the turbines at high speed to develop the needful power. The friction losses incident to the use of gears are in each case taken into the zero reading of the dynamometer, the power observations consequently indicating the power at the pump coupling.

The prime variable in any pump test is the speed. As the driving equipment can be adjusted fine enough to answer pump-testing requirements, it is necessary only to provide an accurate indicating device in order to maintain a given speed. Electric tachometers are used for general speed indication, and a specially developed apparatus known as the synchroscope for the final adjustment. The synchroscope consists essentially of a set of commutators and three neon indicating lamps. One commutator is driven by a gear train from a synchronous motor and, by using gears of suitable size, can be operated at any desired speed. The other commutator is driven by the turbine whose speed is to be held at this rate. The electrical circuit is such that when the commutators are synchronized the neon lights will not flash in procession. If the speed is too low, the procession is in one direction, and if it is too fast the procession is in the opposite direction. The operator merely makes the necessary turbine adjustment to keep the lights stationary, and the turbine speed is then in step with that as set at the gear box.

Motorpumps—motor-driven, direct-connected pumps—ranging in size from ¼ to 50 hp., are tested on a special tank arranged for production testing only. This consists of operating a pump at the designed rating only and of taking observations of the head, capacity, and current input. Suction orifices are used to measure capacity. Three stands are provided: one for ¾-inch, 1-inch, and 1½-inch pumps; a second for 2-inch pumps; and a third for 3-inch and 4-inch pumps. The suction and discharge pipes are spring-suspended in front of their respective stands for ready connection to the pumps. The electrical leads are arranged for safety and for convenience in making connections.

Although the greater part of the laboratory is devoted to testing centrifugal pumps, the direct-acting piston pump is not neglected. Two stands are arranged for production testing of these units, and each one manufactured receives a running test at full pressure and speed.

In order that special tests may be conducted, the laboratory equipment includes special measuring tanks, portable Venturi tubes, various nozzles and orifice plates, a General Radio Strobotac, hand tachometers, gauge-calibrating instruments, suitable electrical meters, and many other instruments necessary for operating a modern pump laboratory.

In some cases, particularly where pumps have been manufactured to meet exacting specifications submitted by the purchasers, tests may assume extensive proportions. Not infrequently pump buyers stipulate running tests extending over a definite period, with perhaps a specified number of starts and stops at certain intervals. Thus far, after ten years of service, the laboratory facilities have proved fully capable of meeting all demands made upon them.

The test laboratory was designed by Frank B. Doyle of the Ingersoll-Rand engineering department.

THE CHANGING WORLD

FOR nearly ten years the world has had impressed upon it the fact that nothing remains static. "Nothing is so permanent as change," is an old adage that is particularly applicable to our times. Roger Babson recently quoted it in cautioning investors that constant vigilance is necessary to maintain the value of one's financial holdings.

Few persons realize the rapidity with which changes come in the business and industrial fields. To emphasize this point, Babson listed 63 makes of automobiles that were once popular but have now passed into the limbo of forgotten things. The list was only partial, for during the period from 1903 to 1926 as many as 181 automobile companies were formed, with only 44 of them surviving. Since 1926 there have been further casualties.

To obtain a cross section of securities prices from day to day, the average of a selected list of leading stocks is taken. It is significant to note that this list is continually changing, and that only a few stocks of industrial companies that were on it 30 years ago remain there today. Conversely, some of the present bellwether concerns were little known or even nonexistant when the century began.

In our great-grandfathers' time, an interest in a well-established firm that manufactured buggies would have been considered a prime investment, while anyone who sought money for making airplanes would have been laughed at. Now the reverse is true. Following the horse-and-buggy days, phonographs were all the rage, but the radio came along to sound their doom. Similarly, steel has largely supplanted wrought iron in many applications, and steel, in turn, has felt the inroads made on it by aluminum, bronze, zinc, and other metals. Corrugated paperboard cartons have made the once familiar wooden box a rarity; and rayon has become a serious competitor of silk.

Dozens of other illustrations of the changing trend might be mentioned, but enough have been given to emphasize the point that no industry is secure. The best insurance against being swept upon a dry beach by the swirl of technological progress is research. Those companies that continually peer into the future have the best chance of anticipating changing trends and of profiting by them. The leading concerns in every industrial line are those that believe in and foster research. If intelligently administered, it meets reverses before they arrive. The International Nickel Company successfully combated the greatest depression the world has ever known by discovering new uses for nickel to replace the loss in volume of sales in established markets. So well was the job done that 1937 was a banner year for nickel, with much of it going into products that required none of the metal as recently as 1929.

DIESEL ANNIVERSARY

THE first commercially successful diesel engine was built 40 years ago. Singularly enough, it was made in the United States, although Dr. Rudolf Diesel originated this type of prime mover abroad. His first engine used coal dust for fuel, and blew up as soon as it was started. The first American engine consumed oil, but otherwise it conformed closely to Diesel's specifications.

The maker of the first American diesel was the Diesel Motor Company of America. That concern was backed by Adolphus Busch, and was the predecessor of the Busch-Sulzer Bros. Diesel Engine Company. Mr. Busch was among the first to recognize the importance of Diesel's invention. He sought the advice of Col. E. D. Meier as to its possibilities, and together they visited Augsburg, Germany, where Diesel was conducting his tests. Impressed by the fact that the diesel showed a thermal efficiency three times that of any steam engine then in operation, Mr. Busch bought the exclusive rights to manufacture the new type of prime mover in the United States and Canada and immediately opened a plant in St. Louis. The first engine was a 2-cylinder, 60-hp. unit, and it was put to useful work in the Anheuser-Busch brewery in St. Louis in September, 1898. The first commercial diesel built abroad appeared later the same year. It was a single-cylinder unit of 25 hp.

The introduction of the diesel was a slow and laborious undertaking, and up to 1905 only 67 engines had been placed in operation in the United States. Its popularity really dates from about 1916, at which time the curve of production began to rise perceptibly. At present there are nearly 50 recognized manufacturers of diesel engines in this country, and their combined output is more than 1,000,000 hp. a year. The units making up this total range from 5 to 20,000 hp. each, and run at speeds up to 3,000 rpm.

As is well known, the operation of the diesel engine differs from that of the gasoline engine in that the fuel is ignited by the heat of compression instead of by a spark. In both instances, the vaporized fuel is diffused with air, and the heat of combustion of the mixture causes expansion that does the work. In a water-jacketed cylinder, air that is drawn in on the suction stroke is heated to around 900°F. when compressed to 500 pounds pressure. Oil is then injected, and as it will ignite spontaneously at about 680°F. if sufficient air is present it begins to burn instantaneously. By injecting the oil slowly or rapidly, the operating speed of the engine can be controlled very closely.

The high pressures demanded by true diesel engines necessitate heavy construction. To obviate this and still retain the economies that result from the use of heavy oil, engines with spark-plug ignition have been developed. In these, of which the Ingersoll-Rand Type H is an example, the compression and maximum pressures are only about one-third of those set up in a true diesel, and, consequently, such engines are but little heavier than gasoline units of equal power.

Moscow's Subway Problem

APPROXIMATELY 25 miles of underground railways have been built or are under construction in Moscow, Russia, as a part of that city's program of modernizing its transport facilities. An accompanying sketch shows the routes of these lines, which constitute half the mileage of the complete system that is at present scheduled. The first section was opened for traffic in May, 1935, and carried 77,000,000 passengers the first year of operation. The second year there were 110,000,000 riders without an accident. Since that time other lines have been put in service.

Virtually all the lines are in tunnels driven at considerable distances below the street levels, as contrasted with the shallow excavations made by the cut-and-cover method for many of the American subways. The tunnels of the sections now under construction are from 100 to 160 feet underground, or much deeper than the earlier ones. The first bore was excavated by ordinary mining methods and was lined with concrete: the newer ones have been driven with the aid of shields and are lined with cast-iron segments. Varying strata have been encountered, including considerable rock, which has added to the difficulties. The tunnels have an internal width of 18 feet. Tracks are of 5-foot gauge and were at first laid on a roadbed of crushed rock; but this has been changed to concrete because of its lower upkeep costs. Rails are now being welded, and this is reported to have reduced maintenance costs and to have improved riding comfort.

Recently built lines have a capacity of one train every two minutes in each direction, but only half that number will be run until traffic grows heavier. The subway stations differ from one another architecturally and have individual color schemes. Walls and columns are faced with marble and decorated with bronze. Ventilating air is drawn in from outside and is conditioned to maintain an equable temperature. Stations are built to accommodate 8-car trains, but 6-car units are at present sufficient to handle the traffic. Coaches are constructed of welded steel, are well lighted, and have power-operated doors with controls that prevent trains from being started until all doors are closed. Coaches on different lines are distinguished by different colors. Average speeds, including station stops, were 20 miles an hour at first, but have been increased to 26 miles. The highest speed permitted is 45 miles an hour. Automatic signaling systems of the latest approved types are installed.

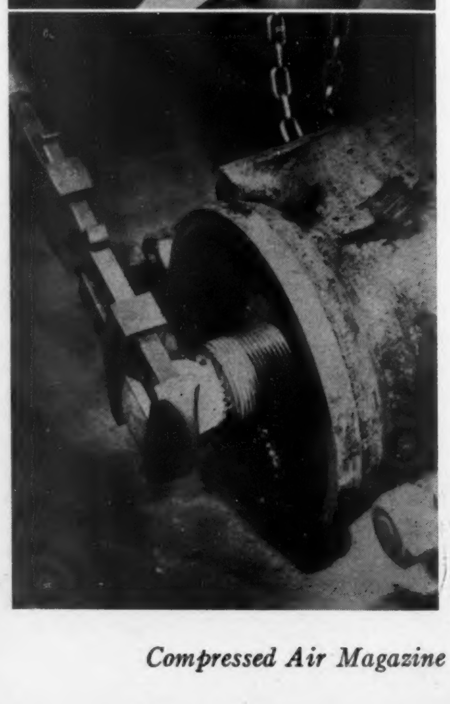
The construction of these subways is but one phase of the program to provide Moscow with better means of communication necessitated by its rapid growth. Existing streets are being widened to 100 and 130 feet in older parts of the city and to as much as 230 feet in newer sections. New streets are being built, and five new bridges across the Moscow River are in course of construction. One of the new streets will cross the entire city, terminating at the Palace of the Soviets, which is to be the world's largest structure. This building, which was described in our March issue, will contain 62 escalators and 99 elevators.

During the past twenty years, Moscow's population has more than doubled. It is now around 4,000,000, and the city planners envision an increase of 1,000,000 more during the next few years. During 1936 the tramways, buses, subways, and river ferries carried 2,136,000,000 passengers.

Handy Tool for Maintenance Man

WITH a wrench and a Reps Extractor it is possible, says the manufacturer of the latter, to remove a broken stud, screw, bolt, or threaded pipe neatly and quickly without hammering and damaging associate parts. Described as a trick tool, the Reps Extractor is the invention of a maintenance engineer of long standing. It is a combination 4-point grip and reamer made of a solid piece of forged steel with a Brinell hardness of 490, which is much greater than that of any of the metals with which it would be brought in contact.

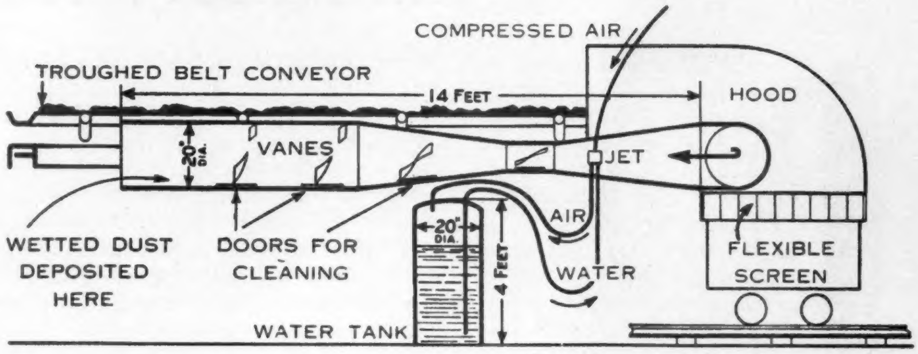
There are ten extractors in a set to fit all studs, screws, and bolts from 7/16 inch to 3½ inches, as well as standard, heavy, and extra-heavy pipe of iron, steel, bronze, brass, and special alloys ranging in diameter from ⅛ inch to 2 inches. Each one is numbered, and a table in the lid of the box in which they are conveniently packed specifies the size required for a given job. To remove a broken piece of 1-inch pipe, for example, No. 6 Extractor is inserted into it so that all four points of the tool bite at the same time. That done, it is turned by means of a wrench in the direction followed by its threads. If the extractor has been properly centered, the piece comes out easily; and the hold of the extractor is released by turning it in the opposite direction. In the case of studs, screws, or bolts, the procedure is the same with one exception: it is necessary first to drill a hole right in the middle of the broken part to take the shallow grip of the tool.



Manifold Sprays Liquids Under Pressure

FOR conditioning and finishing fabrics, paper, and the like in textile mills, printing plants, cordage works, etc., R. I. Humidifier & Vent Company has produced a spray manifold, or Web Spray as it is called. It permits water, oil, or emulsions of different kinds to be sprayed on the moving material, the length of the manifold and the number of the nozzles varying with the work. Connected to the manifold by two pipes—one for compressed air and the other for whatever liquid is used—is a humidifier head to which the air and fluid are fed separately. Air at a minimum pressure of 25 pounds per square inch is used to open the head and to force the liquid into the line leading to the manifold. At this point atomization begins. The amount of the fluid and the degree of atomization are controlled either manually or automatically by two pressure regulators, one in the liquid feed pipe between the source of supply and the humidifier and the other in the air line between the humidifier and the manifold. The latter can be turned so as to direct the spray at any desired angle, and, together with the rest of the equipment, is made of rustproof material.

Pneumatic Dust Extractor for Collieries



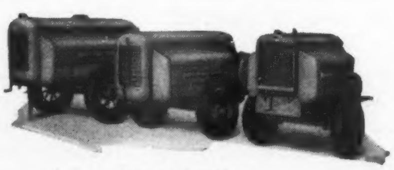
TRAVELING conveyors which are being used increasingly in collieries to transport coal underground have led to the development in England of a dust extractor that is set up at transfer and loading stations to keep the atmosphere clear. These points, by reason of the newer method of transportation, are now largely centralized, and the great quantities of coal handled there create dense clouds of dust that obscure vision and make for uncomfortable and unsafe working conditions. It was to check this nuisance and menace that the extractor was invented and brought to a practical stage by Messrs. F. S. W. Dobbs and James Anderton. It has since been acquired by Mavor & Coulson, Ltd., which company has improved it and is now manufacturing it on a commercial scale.

The M & C Dust Extractor, as the accompanying drawing shows, consists of two cylindrical compartments connected by a narrow passage or throat, of a combination air and water jet in the front chamber, of a separate pressure tank, and of a hood beneath which the coal cars are loaded. The hood, together with a flexible screen, is mounted on each car, in turn, and extends over the delivery end of the conveyor. As the coal falls into the car the dust is drawn into the extractor, in which a current of air is induced by means of the jet, and water from the tank is forced by compressed air into the front compartment in which it is liberated in the form of a fine mist by the jet. The water feed is adjustable and independent of reasonable variations in air-line pressure. The jet is arranged to give the water and the air a whirling motion that is progressively increased by vanes in the throat and back chamber, thus bringing about a thorough admixture of the mist and dust-laden air. The second compartment is provided with doors for the removal of the deposited material.

The device has undergone extensive service tests with both dry and moist dust-laden air. The mechanism is said to operate quietly and with an efficiency of more than 90 per cent when water is used just as it comes from the tap. Still higher efficiencies are obtainable when a wetting agent is added to the water to reduce its surface tension. Obviously, checking coal dust at the source at underground loading stations in coal mines has a number of advantages, not the least of which is an atmosphere that can be breathed by the workers without difficulty and that enables them to see what they are doing. Furthermore, with less coal dust to contend with, the amount of rock-dusting required is proportionately reduced.

New Trailer Compressors

AN ANNOUNCEMENT has recently been made by Ingersoll-Rand Company that it has added three models of a new trailer type to its line of air-cooled portable compressors. They are light-weight, 2-wheeled units of sturdy construction for towing at speeds up to 35 miles an hour, and have built-in tool boxes of commensurate size as well as hinged covers that fold back like the hood of an automobile.



TRAILERS
The three new light-weight, air-cooled portable compressors Models 105A, 85A, and 55, reading left to right.

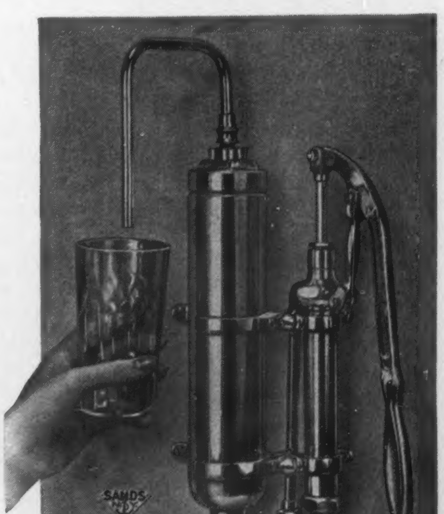
Model 55—the smallest—is a single-stage compressor with a rated capacity of 55 cfm. at 80 pounds pressure. It is driven by a Waukesha gasoline engine, and has spring-mounted, Timken roller-bearing wheels with pneumatic tires. Models 85A and 105A are 2-stage machines delivering, respectively, 85 and 105 cfm. at 100 pounds pressure. Each is equipped with a fuel tank and an air receiver, mounted end to end; can be furnished with either pneumatic or solid tires; and is designed for operation by either a gasoline or an oil engine.

Full details regarding the new portables are contained in Bulletin No. 3264, which covers the complete line ranging in capacity from 55 to 420 cfm. Copies are available at the company's main office, 11 Broadway, New York, N. Y., or at any of its branch offices, and can be obtained upon request.

Pure Drinking Water Anywhere

TO SUPPLY pure drinking water from any available source, even if badly contaminated, is a large order for a portable filter that, together with its hand-operated pump, measures only 15 inches from top to bottom and weighs but 8 pounds. Yet the San-Aqua Filter is said to do just that, and to be ideally suited for use anywhere beyond the beaten track—in mining and other camps, on farms, as well as on motor boats and trailers. The unit can be easily mounted on a wall or bulkhead, and is connected with the source of supply by a ¼-inch pipe attached to the lower end of the pump. However, where water pressure is available, the filter alone is adequate. Both pump and filter are built of heavily chromium-plated brass and bronze so as to withstand corrosion.

The filter's effectiveness lies in the Katadyn processed silver sand with which it is filled. These small, porous pebbles release electrically charged silver ions which kill the bacteria in the water as it passes through them. Besides, they penetrate the filter wall of diatomaceous earth, thus sterilizing it and preventing it from becoming a breeding place for germs, as is generally the case. For that reason cleaning is unnecessary unless the flow is very limited. The filter member or candle is good for approximately 4,000 gallons of water, and can be easily renewed. Oil fields on the Island of Trinidad, where rain water is collected in tanks and used for drinking purposes, have been provided with San-Aqua filter pumps; and the Pound Expedition, which is now on its way up the Amazon River in South America, is equipped with them to protect its members from water-borne diseases.



Industrial Notes

With the new screw driver put on the market by Stanley Tools you'll be able to see what you are doing because it is combined with a flashlight. Besides throwing light on the work, it is of pocket size and provided with a clip so you will have it when you want it. The blade is 2 inches long and 1/8 inch in diameter, and has an accurate cross-ground tip. It is made of tempered steel, while the octagon-shaped handle is of brass and neatly finished in black and orange. It holds one standard battery and light bulb that can be easily renewed. Flash-lite is the name of the new tool, and it retails for $1.00.

Foodstuffs packed in silver-lined cans that kill germs may soon be procurable, according to the U. S. Bureau of Standards. The latter, in coöperation with the silver producers of America, has developed a "relatively inexpensive" container of this description.

Now that marble is available in tile form, the average homebuilder may be able to consider that material for his bathroom walls and for use in kitchens and elsewhere where its beauty and cleanliness recommend it. Markwa is the name of the tile, which is produced by the Vermont Marble Company.

In Switzerland, with its large mileage of stabilized roads, a mixture of bitumen and rock dust is being used as a stabilizing material. Coating of the rock dust with the bitumen, says *Mineral Trade Notes*, is effected while both are in suspension, and the resultant binder, when mixed with the proper proportion of stone aggregate, assures a firm surface through which the bitumen will not rise as free sticky pitch.

Production of metallic magnesium from low-grade ores by a new, patented process is soon to get underway near Liverpool, England, where the Lancashire Metal Subliming Corporation, Ltd., is erecting special electric furnaces for the purpose. The ultimate plan calls for twenty of them with a capacity of 3,000 tons annually. It is claimed that the process is suitable for the manufacture of all metals that lend themselves to sublimation—aluminum, ferrochrome, beryllium, and others—and that it will enable the company to produce magnesium at a fraction of the present cost.

Henry Vogt Machine Company has announced recently that its drop-forged steel valves now have Parkerized valve bonnets, bonnet nuts, packing glands, and packing nuts as a protection against atmospheric corrosion. This prevents galling of threads, and makes it easy to service the valves and to maintain operating efficiency. Another innovation is an identification disk held in place by the hand-wheel nut. On this are recorded the valve size, catalogue number, working pressure and temperature, and style of trim—all the information the user needs to order replacement parts.

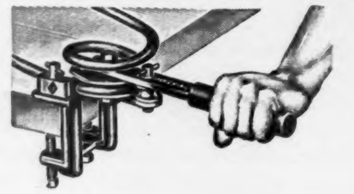
As a substitute for heavier-gauge, solid stainless steel, the Ludlum Steel Company has developed a composite material, called Ludlite, that is said to serve the same purpose at less cost. It consists of a thin sheet of stainless steel firmly bonded to a nonmetallic material that is tough, flexible, waterproof, and has soundproofing and insulating properties. Ludlite can be had in the form of molding, tiles, or in rolls 2 feet wide and 50 or 100 feet long. According to the manufacturer, it can be readily cut with thin snips, shaped or bent by hand, and nailed, screwed or cemented to plaster, fiber board, concrete, and other surfaces.

To its line of more than 300 goggles, Willson Products, Inc., of Reading, Pa., has added a new type, Style WV1, a spectacle goggle provided with supertough lenses and designed for maximum protection and comfort. It is available in various assemblies to meet individual requirements, and is especially suitable for use in industries where falling or flying objects present a serious eye hazard. The goggles are made either with a comfortable, broad saddle-

nose bridge or with rocker nose pads; either with or without wire-screen, leather, or transparent sonite side shields; and with clear or special lenses of different kinds. The accompanying illustration shows a pair of spectacle goggles with clear, wide-view lenses and rocker nose pads.

The next step towards providing ideal working conditions for men and women in offices and factories will be a system of radiation to purify the air they breathe. Realizing that comfort and well-being promote efficiency and increase output, most new plants are being air conditioned. And it is conceivable that the day will soon come when lamps, such as are now being used to sterilize the air in operating rooms, will be placed in offices and elsewhere to reduce the bacteria count and thus to safeguard workers especially from the common ills to which they are now subjected and which represent a heavy loss annually in the form of nonproductive man-hours.

With its new combination tube bender and coil maker, The Imperial Brass Manufacturing Company has provided a handy



little tool that will bend tubing to any desired angle up to 180° and make return bends as well as coils, both round and obround (rectangular with rounded corners), varying from 3 to 6⅜ inches in diameter. It comes in four sizes for aluminum, brass, and copper tubing of 3/8, 1/2, 5/8, and 3/4 inch outside diameter and ranging from 0.02 to 0.065 inch in thickness. Imperial No.460-F, as the tool is designated, is designed to be clamped to a bench. It is said to do neat and accurate work without flattening or crimping the tubing.

Travel by direct rail route from Asia to North America! That is what the Russian government is proposing. The plan is to drive a tunnel under shallow Bering Strait from Cape East, Siberia, to Cape Prince of Wales, Alaska, a distance of 38 miles, and thus to connect the Trans-Siberian Railway—which is to be extended for the purpose—with Canadian and United States lines. Preliminary exploratory work indicates that the tunnel would penetrate solid rock and could be advanced simultaneously from six headings, one from each end and four from two islands in its path. It is reported that a Soviet delegation is to be sent to North America to present the matter to the respective governments.

Automobiles with rubber cushions and backs are forecast as a result of the development by the Goodyear Tire & Rubber Company of a new product called Airfoam. It is 95 per cent pure latex, and so porous that air is caused to circulate through the material with every movement of the occupants, thus keeping it at a comfortable temperature. Under pressure, the air in the cushions escapes, so that they adjust themselves to any position of the body: when pressure is released they resume their original form. Unlike sponge rubber—which is solid sheet rubber treated with chemicals, the latex is beaten into a froth and cured in molds shaped to meet the manufacturers' needs. In addition to the advantages already cited, Airfoam is said to be odorless, dustless, slightly antiseptic, and proof against moths and vermin.

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